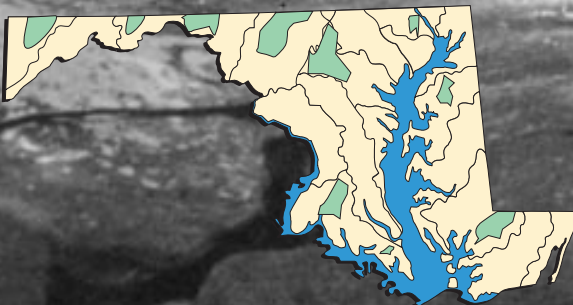
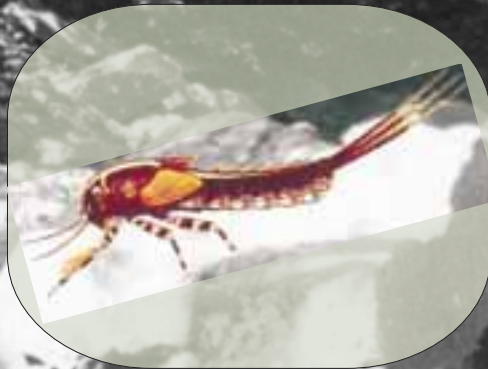


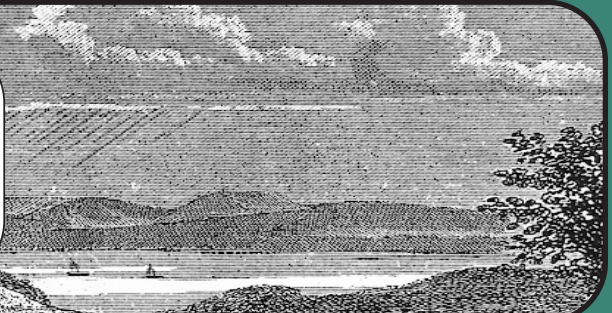
MARYLAND BIOLOGICAL STREAM SURVEY 2000-2004



VOLUME I ECOLOGICAL ASSESSMENT OF WATERSHEDS SAMPLED IN 2000



**CHESAPEAKE BAY AND
WATERSHED PROGRAMS
MONITORING AND
NON-TIDAL ASSESSMENT
CBWP-MANTA-EA-01-5**





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MARYLAND BIOLOGICAL

STREAM SURVEY 2000-2004

**Volume I: Ecological Assessment
of Watersheds Sampled in 2000**

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August 2001

FOREWORD

This report, *Maryland Biological Stream Survey 2000-2004, Volume I: Ecological Assessment of Watersheds Sampled in 2000*, supports the Maryland Department of Natural Resources' Maryland Biological Stream Survey (MBSS) under the direction of Dr. Ronald Klauda and Mr. Paul Kazyak of the Monitoring and Non-tidal Assessment Division. Versar's work and this report were prepared under Maryland's Power Plant Research Program (Contracts No. PR-96-055-001 and K00B0200109 to Versar, Inc.). A major goal of the MBSS is to assess the ecological condition of Maryland's streams, with a particular focus on biological resources, but also evaluating water chemistry and physical habitat. Round Two of the MBSS was designed to characterize and assess watersheds over a five year cycle (2000-2004). This annual report presents results from watersheds sampled in 2000. This report includes a history of the program, a description of methods and survey design, comparative assessments by watershed, detailed results for individual watersheds, comparisons with Round One results (from 1995-1997), and preliminary analysis of 2000 data using the state's currently proposed biological criteria.

ACKNOWLEDGMENTS

The 2000 MBSS has been a cooperative effort among several agencies and consultants. We at Versar wish to thank Ronald Klauda and Paul Kazyak from the Maryland Department of Natural Resources (DNR) for directing the program and supporting Versar in preparing this report. Maryland DNR and the University of Maryland's Appalachian Laboratory (AL) each provided field crews and did a great job collecting the data. Maryland DNR digitized watersheds and calculated land use data, provided quality assurance, conducted crew training, and performed field sampling. Paul Kazyak and Tony Prochaska of Maryland DNR contributed to writing this report. Mark Southerland and Paul Kazyak served as its editors. Dr. Ray Morgan of the University of Maryland's Appalachian Laboratory supervised one field crew and oversaw water chemistry laboratory analysis. Dr. Rich Raesly of Frostburg State University provided taxonomic verifications of voucher fish specimens. Versar designed the sampling program, obtained landowners' permissions, conducted statistical analyses, and prepared this report.

The success of the project resulted from the strong efforts of all these groups. We particularly thank the key individuals listed below for their contributions:

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EXECUTIVE SUMMARY

This report presents the results of the first year of the second round of sampling conducted by the Maryland Biological Stream Survey (MBSS or the Survey) to assess the “state of the streams” throughout Maryland. The year 2000 was the first of five years of sampling planned for Round Two. Results for each year of Round Two will be reported annually and a summary report will be published when Round Two sampling is completed.

Background. Supported and led by the Maryland Department of Natural Resources (DNR), the MBSS is a comprehensive program to assess the status of biological resources in Maryland's non-tidal streams; quantify the extent to which acidic deposition affects critical biological resources in the state; examine which other water chemistry, physical habitat, and land use factors are important in explaining stream conditions; provide a statewide inventory of stream biota; establish a benchmark for long-term monitoring; and target future local-scale assessments and mitigation measures needed to restore degraded biological resources. To meet these and other objectives, the Survey has established a list of questions of interest to environmental decision makers to guide its design, implementation, and analysis. These questions fall into three categories: (1) characterizing biological resources and ecological conditions (such as the number of stream miles with $\text{pH} < 5$), (2) assessing their condition, and (3) identifying likely sources of degradation.

To answer these questions, a number of steps have been taken since the Survey's inception, including (1) devising a sampling design, (2) field testing sampling protocols and logistics to assure data quality and precision, (3) conducting an extensive, multi-year field sampling program, (4) developing reference-based indicators of biological integrity, and (5) using analytical methods to evaluate contributions of different anthropogenic stresses, including land use. Three characteristics of the Survey differentiate it from other stream monitoring efforts in Maryland. First, sampling is probability-based, allowing accurate and robust population estimates of variables and sampling variance, so that estimates of status can be made with quantifiable confidence. Second, the Survey focuses on biological responses to stress, but also collects data to characterize pollutant stress and habitat condition. Third, its scale is watershed-wide and statewide, rather than local.

MBSS 2000 Design. 2000 was the first year of sampling for Round Two of the Survey. Round Two includes both

(1) a core survey based on statewide sampling of random stream segments and (2) ancillary sampling dedicated to additional monitoring and special studies. The core survey produces the majority of MBSS results and is the focus of this report. Some information gathered by the ancillary sampling is included, but extensive data analysis of these additional results is reserved for separate reports.

To meet the State's growing need for information at finer spatial scales, Round Two's core survey was redesigned to focus on Maryland's 8-digit watersheds (averaging 75 mi^2 in area) rather than drainage basins (averaging 500 mi^2). The Round Two design is based on first-through fourth-order, non-tidal streams on a new 1:100,000-scale base map. The study design allows estimates at the level of 84 individual or combined Maryland 8-digit watersheds that serve as primary sampling units (PSUs). Each PSU has 10 or more sample sites. To achieve this sample density while sampling approximately 210 sites each year, Round Two will take five years to complete, running from 2000 through 2004 (rather than the three years in Round One, 1995-1997).

The MBSS uses a probability-based survey design called lattice sampling to schedule sampling statewide over a multi-year period. The lattice design of Round Two stratifies by year and PSU and restricts the sampling each year to about one-fifth of the state's 138 watersheds. Approximately 300 stream segments (210 in the core survey) of fixed length (75 m) are sampled each year, with biological, chemical, and physical parameters measured at each segment using standardized methods. Biological measurements include the abundance, size, and individual health of fish; taxa composition of benthic macroinvertebrates; and presence of amphibians and reptiles, mussels, and aquatic vegetation. Chemical analytes include pH, acid-neutralizing capacity (ANC), nitrogen, phosphorus, sulfate, chloride, conductivity, dissolved oxygen (DO), and dissolved organic carbon (DOC). Physical habitat parameters include commonly used observational measurements such as instream habitat structure, embeddedness, pool and riffle quality, shading, and riparian vegetation, and quantitative measurements such as stream gradient, maximum depth, wetted width, and discharge. Channelization, bank erosion, bar formation, and land use immediately visible from the segment are assessed. Additional land use data for the entire catchment upstream of each sample site are incorporated from statewide geographic information system (GIS) coverages.

For the most part, methods used in Round Two are identical to those of Round One. However, some changes were made to improve the quality and/or usefulness of the data generated. These changes in sampling methods include (1) modifications to habitat assessment and characterization, (2) the addition of new chemical analytes (total dissolved nitrogen, total particulate nitrogen, nitrite nitrogen, ammonia, ortho-phosphate, total dissolved phosphorus, total particulate phosphorus, chloride, and turbidity), (3) collection of continuous temperature readings in the summer, (4) characterization of invasive plant abundance, and (5) the addition of altitude as a physical variable. In addition, the reach file used to select sites is the USGS 1:100,000-scale map; this is a change from the 1:250,000-scale map used in Round One, meaning that more small streams will be sampled in Round Two. Another change to the sample frame is the inclusion of fourth-order streams.

Although the Survey will provide the data needed to characterize the status of all 8-digit watersheds, it will not have sufficient sampling density to characterize most of the 1066 12-digit subwatersheds. Therefore, Round Two of the MBSS has been expanded to include coordination with volunteer efforts (such as Maryland Stream Waders) and County stream monitoring programs. Ultimately, by incorporating these data, the MBSS hopes to characterize many areas of the state at this finer spatial scale.

In addition to improving the spatial intensity of sampling, Round Two will address temporal variability by regular monitoring of fixed “sentinel” sites. In 2000, DNR established a network of approximately 25 sentinel sites deemed to be minimally impacted by human activities, in areas where land uses were unlikely to change over time (e.g., state parklands).

Ancillary sampling was conducted in 2000 to serve four additional purposes: (1) to provide more data for applying biocriteria in the Lower Monocacy watershed, (2) to collect additional data in coldwater streams to support indicator development for this stream type, (3) to support stream assessment for the Gwynns Falls Long Term Ecological Research (LTER) program, and (4) to provide baseline ecological data from streams that the U.S. Army Corps of Engineers intends to restore.

MBSS 2000 Results. In 2000, the Survey continued to provide invaluable information on the abundance and distribution of rare species, in order to support a more thorough understanding of Maryland’s biodiversity. During MBSS sampling in 2000, a number of rare or unusual occurrences of fish were documented, including unusual

records or range extensions for the state-listed glassy darter, mud sunfish, flier, and ironcolor shiner, as well as the Potomac sculpin, pearl dace, checkered sculpin, banded sunfish, American brook lamprey, swamp darter, and brook trout.

The status of sampled watersheds and individual stream segments was assessed, focusing on the condition ratings of the fish and benthic Indices of Biotic Integrity (IBI), indicators previously developed by MBSS and employed in evaluating Round One results. IBI scores for each site were determined by comparing the fish or benthic assemblage to those found at minimally impacted reference sites.

IBI data for each PSU are depicted in box-and-whisker plots; mean IBIs for PSUs sampled in 2000 were mapped. Over the next four years of Round Two sampling, data will be collected in remaining PSUs to complete an updated statewide picture of biological conditions. Data were also used to estimate the extent of streams in poor to very poor condition ($IBI < 3$) within each PSU. The MBSS Round Two study design, based on simple random sampling, makes it possible to calculate an exact confidence interval around each estimate based on the binomial distribution. The extent of streams within a given condition (e.g., $IBI < 3$) is expressed as a percentage of all first-through fourth-order stream miles in the PSU, with an associated 90% confidence interval around the estimate.

The indicators used were developed during Round One of the MBSS and have been deemed reliable for representing ecological condition by field verification and expert peer review. Nonetheless, the MBSS continues to pursue refinements to its indicators including improvements to the provisional physical habitat index (PHI), methods for combining indicators that do not lose information (e.g., combined biotic index), and changes to the indicator thresholds and scoring methods to make them more intuitive and accessible to the public.

Fish IBI scores at sites sampled in the 2000 MBSS spanned the full range of biological condition, from 1.0 (very poor) to 5.0 (good). Mean fish IBI per PSU ranged from 2.12 (Potomac River Washington County/Marsh Run/Tonoloway/Little Tonoloway) to 3.98 (Liberty Reservoir). Fish IBI scores were less variable within some PSUs (e.g., Liberty Reservoir, Brighton Dam, South Branch Patapsco) than others (e.g., Town Creek, Fifteen Mile Creek).

Benthic IBI scores spanned the full range of biological conditions, from 1.0 (very poor) to 4.78 (good). The lowest mean benthic IBI was 1.60 in Lower Wicomico/Monie

Bay/Wicomico Creek/Wicomico River Head PSU; however, the presence of several blackwater stream sites may have contributed to low scores. The highest mean benthic IBI was 3.96 in Prettyboy Reservoir PSU. Within-PSU variability ranged from low (Fifteen Mile Creek, Potomac River Washington County, Liberty Reservoir, and Prettyboy Reservoir) to high (Casselman River). The greatest extent of occurrence of streams with benthic IBI < 3 (expressed as 90% confidence intervals) was in Aberdeen Proving Ground/Swan Creek (53 to 97% of stream miles) and Lower Wicomico/Monie Bay/Wicomico Creek/Wicomico River Head PSU (61 to 99% of stream miles).

To integrate the results of fish and benthic IBI assessments, a Combined Biotic Index (CBI) was calculated as the mean of the fish and benthic IBI values at a site. If only one score was available (e.g., benthic but no fish IBI) the single score was assigned as the CBI. CBI scores from core MBSS sites ranged from 1.0 (very poor) to 4.67 (good). Mean CBI per PSU ranged from 1.79 (Lower Wicomico/Monie Bay/Wicomico Creek/Wicomico River Head) to 3.82 (Prettyboy Reservoir), paralleling benthic IBI results.

The effects of acidic deposition and acid mine drainage (AMD) on stream chemistry are well documented. Round One MBSS results (Roth et al. 1999) and an assessment of these results in comparison with critical loads (Miller et al. 1998) confirmed that stream acidification remains a problem in Maryland freshwater streams. In 2000, estimates of the percentage of stream miles sensitive to acidification (i.e., those with ANC < 200 $\mu\text{eq/l}$) followed the geographic pattern noted in the MSSCS and Round One MBSS, with the greatest extent of acid-sensitive streams in Western Maryland and the Southern Coastal Plain. Eight PSUs, primarily in the same regions, had sites highly sensitive to acidification (ANC < 50 $\mu\text{eq/l}$).

Although many water resource programs tend to focus on water chemistry-based definitions of stream quality, physical habitat degradation can have an equal or greater effect on stream ecosystems and their biological communities. A provisional Physical Habitat Index (PHI), developed using earlier MBSS data (Hall et al. 1999) was used to score sites sampled in 2000. PHI scores varied widely within and among PSUs. The mean PHI fell into the range of good in six PSUs, all in central and southern Maryland (Mattawoman, St. Mary's River, Brighton Dam, Little Patuxent, Liberty Reservoir, and Prettyboy Reservoir). Mean PHI was poor in three PSUs (Town Creek, Aberdeen Proving Ground/Swan Creek, and Lower Wicomico/Monie Bay/Wicomico Creek/Wicomico River Head) and fair in the remaining nine PSUs. Stream mile estimates of the

occurrence of poor to very poor PHI scores suggest that physical habitat degradation is widespread.

MBSS 2000 results indicate that stream channelization is common in some Maryland watersheds, particularly in the Coastal Plain. Moderate to severe bank erosion also occurs commonly in Maryland streams. Mean values by PSU were used to estimate the extent of eroded area (square meters) per stream mile. Highest values were in Little Patuxent, Brighton Dam, and South Branch Patapsco PSUs. The combined area of eroded bank in all 18 PSUs totaled nearly 400 acres. Exacerbated bar formation was observed in most watersheds sampled in 2000. Lack of riparian vegetation on at least one stream bank was observed within 12 of 18 PSUs. Watersheds of Central Maryland and the Eastern Shore appeared particularly affected by the presence of exotic plants, such as multiflora rose, mile-a-minute, and Japanese honeysuckle. The total number of instream pieces of woody debris and rootwads was substantially higher in Lower Wicomico/Monie Bay/Wicomico Creek/Wicomico River Head PSU than elsewhere.

During 2000, MBSS deployed continuous reading temperature loggers at more than 200 sites. The long-term goal is to use temperature data to (1) better characterize coldwater streams and (2) identify streams stressed by temperature changes, such as spikes from rapid inputs of warm water running off impervious surfaces during summer storms. Among all sites assessed, mean average daily temperatures ranged from 13.7 to 24.5 °C, indicating the presence of both coldwater and warmwater sites in the data set. Future analyses of data from coldwater streams will assist in interpretation of IBI scores and will contribute to development of a fish IBI tailored to these systems, because trout and several non-game species require cool to cold waters. Four sites had occasional readings above 32 °C, but none more often than 0.5% of the time.

In Maryland, concern for nutrient loadings to the Chesapeake Bay has drawn attention to the amounts of nitrogen and phosphorus transported from throughout the watershed by stream tributaries. In MBSS 2000 sampling, total nitrogen tended to be highest in Central Maryland and the Eastern Shore, as well as Potomac River Washington County/Marsh Run/Tonoloway/Little Tonoloway and Upper Monocacy PSUs. In general, nitrate nitrogen made up the largest fraction of total nitrogen. Nitrate nitrogen concentrations greater than 1 mg/l are commonly considered to indicate anthropogenic influence; mean nitrate nitrogen concentrations exceeded this level in 11 of 18 PSUs. In several PSUs, nearly 100% of stream miles had high nitrate nitrogen concentrations. Total phosphorus tended to be

substantially higher on the Eastern Shore, lower in Western Maryland, and moderate in the central part of the state.

Dissolved oxygen concentrations at most locations were greater than 5 mg/l, the COMAR standard and a level generally considered healthy for aquatic life. The only PSU with a mean DO < 5 mg/l was Lower Wicomico/Monie Bay/Wicomico Creek/Wicomico River Head, where swampy blackwater streams and sluggish waters are naturally lower in DO, but are also particularly susceptible to BOD loading from anthropogenic sources. As expected, turbidity was generally low, but a more complete characterization of turbidity would require sampling during storm events. Sulfate values were not generally high. Chloride tended to be highest in urban areas, and also at several sites near roadways that probably received substantial amounts of road salt. As expected, mean DOC and particulate carbon were highest in Coastal Plain basins, especially on the Eastern Shore.

Since the primary focus of the Round Two Survey is on smaller watersheds than in Round One, more attention has been paid to examining sampling results and potential stressors at individual sites. This report includes a snapshot of good and bad conditions that is illustrated by sites with the 10 best and 10 worst CBI scores. The report also includes a summary of results for each of the 18 PSUs sampled in the core sampling for MBSS 2000, as well as the Lower Monocacy River watershed, sampled specifically in 2000 to support application of biocriteria. Each summary includes maps, land use statistics, and tables containing a variety of information on the sites sampled in each PSU. Additional data are available on a Web-based searchable database at www.dnr.state.md.us/streams.

As each round of statewide sampling by the Survey is conducted at regular intervals over time, temporal changes (trends) in the stream condition statewide or for individual 8-digit watersheds can be evaluated. A comparison with data from Round One (1995-1997) was conducted where sample sizes were sufficient (i.e., in the nine 8-digit watersheds sampled in 2000 that also had more than 10 samples in one or two years of MBSS Round One). Yearly estimated 90% confidence intervals for fish or benthic IBI scores overlapped for all watersheds except for the Upper Monocacy, which had an interval of 19.9-60.8% for the benthic IBI in 2000 as compared to the 66.6-90.5% interval in 1996 sampling.

In 2000 the Survey initiated an annual monitoring effort at minimally disturbed sites (referred to as Sentinel sites) to help interpret the degree to which changes in biological indicator scores stem from natural variability. A final list of

27 Sentinel sites most likely to remain undisturbed in the foreseeable future was selected to represent four geographic regions. Comparisons between 2000 and Round One sampling data at these sites showed that many parameters were not dramatically different over time.

Maryland Department of the Environment has developed an interim framework for the application of biocriteria in the State's water quality inventory (305(b) report) and list of impaired waters (303(d) list). At present, the proposed biocriteria for wadeable, non-tidal (first- to fourth-order) streams rely on two biological indicators from the MBSS, the fish and benthic IBIs. The approach centers on identifying impaired waterbodies at the Maryland 8-digit watershed and 12-digit subwatershed levels.

For this report, a preliminary evaluation of MBSS 2000 data was conducted to identify watersheds failing to meet the requirements of the interim biocriteria framework. This analysis is intended to assist the State in preparing the 305(b) report and 303(d) list; however, our results are not intended to be the final determinations of impairment status. Applying the decision rules of the biocriteria framework, only the benthic IBI in Upper Choptank 8-digit watershed had a 90% confidence interval less than 3.0, resulting in an overall status of "fail" for this watershed. In all, three 8-digit watersheds passed and six were inconclusive. Of the sampled 130 12-digit subwatersheds, 69 failed, 32 passed, and 22 were inconclusive. Seven 12-digit watersheds were not rated because sites were removed during a site review process. Using the current framework for defining impairment, it is clear that the majority of 12-digit subwatersheds in Maryland would be classified as impaired (based on 1 or 2 sites), even though the confidence intervals around the extent of the problem are large. Given the uncertainty around these results and the effort required to develop and implement Total Maximum Daily Loads (TMDLs) for each impaired watershed, it may be appropriate for DNR, MDE, and the Biological Criteria Advisory Committee to examine priorities for addressing impairments in the 12-digit subwatersheds.

Management Implications and Future Directions. The information being obtained by Round Two of the MBSS will continue to support a wide array of management decisions by Maryland DNR and other agencies. The Survey results are expected to be highly useful for the new stream corridor commitments of the Chesapeake Bay Program. The Chesapeake 2000 Agreement (signed by Virginia, Maryland, Pennsylvania, District of Columbia, U.S. Environmental Protection Agency (EPA), and Chesapeake Bay Commission) newly recognizes "the need

to focus on the individuality of each river, stream and creek” to meet the goal—“Preserve, protect and restore those habitats and natural areas that are vital to the survival and diversity of the living resources of the Bay and its rivers.”

The stream corridor information provided by the Survey will also prove invaluable for other statewide programs. As part of the Chesapeake Bay-wide goal of restoring 2,010 miles of riparian buffers in the Chesapeake Bay watershed by the year 2010, Maryland has committed to restoring 600 miles of riparian vegetation along its stream corridors. MBSS data on the condition of constituent streams will help assign priorities for the purchase of Greenprint and Rural Legacy lands. The results of Round Two will continue to support Maryland’s participation in the federal Clean Water Action Plan. Round One MBSS data were an essential component of the first Unified Watershed Assessment, helping designate both Category 1 (priorities for restoration) and Category 3 (priorities for protection) watersheds within Maryland. Restoration strategies have been developed for many of these priority watersheds, and 2000 sampling results will be used to help implement them (e.g., in Little Patuxent River watershed). Because the design of Round Two focuses on the finer geographic scale of Maryland 8-digit watersheds, future Unified Watershed Assessments will be more complete.

In addition to supporting these targeting initiatives, the identification of degraded stream segments has implications for comprehensive protection under the Clean Water Act, including use of MBSS 2000 (along with other data) to prepare the State’s Clean Water Act 303(d) list and biennial 305(b) water quality report. MBSS biological data may also contribute to refinement of aquatic life use designations. Based on the information gathered in Round One, Maryland DNR’s Heritage and Biodiversity Programs are reevaluating state designations of rare, threatened, and endangered species.

As described above, the Round Two design provides significantly improved geographic resolution and additional stressor data, although more comprehensive understanding of watershed stressors will require data from other sources. Issues that require continued scrutiny in future years include the following:

- Extending the Survey into tidal streams
- Delineating more stream types requiring new indicators (e.g., coldwater and blackwater streams)
- Refining existing indicators (e.g., physical habitat) and developing new ones (e.g., streamside salamanders in small streams)
- Better characterization of existing and new stressors (e.g., estimating the contribution of eroded soil to sediment loading)
- Improving identification of rare species habitats and other biodiversity components
- Comparing among sample rounds for the detection of trends
- More coordination with counties for greater sample density or cost savings in areas of shared interest

Maryland DNR hopes to achieve better integration of the MBSS with those local government agencies that already have or are planning to initiate their own stream monitoring programs. The Maryland Water Monitoring Council (MWMC) will play an active role in encouraging collaborations between the state and local agencies.

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1 INTRODUCTION

This report presents the results of the first year of the second round of sampling conducted by the Maryland Biological Stream Survey (MBSS or the Survey) to assess the “state of the streams” throughout Maryland. The year 2000 was the first of five years of sampling planned for Round Two. Sampling for the three-year Round One of the Survey was completed in 1997 and was summarized in Roth et al. (1999) and Boward et al. (1999). Results for each year of Round Two will be reported annually and a summary report will be published when Round Two sampling is completed. This introductory chapter describes the history of the Survey, describes its components, and provides a roadmap to this year 2000 annual report.

1.1 HISTORY OF THE MBSS

In the 1980s, the Maryland Department of Natural Resources (DNR) recognized that atmospheric deposition was one of the most important environmental problems resulting from the generation of electric power. The link between acidification of surface waters and acidic deposition resulting from pollutant emissions was well established and many studies pointed to adverse biological effects of low pH and acid neutralizing capacity (ANC) and elevated levels of inorganic aluminum. To determine the extent of acidification of Maryland streams resulting from acidic deposition, DNR conducted the Maryland Synoptic Stream Chemistry Survey (MSSCS) in 1987. The MSSCS estimated the number of streams affected by or sensitive to acidification statewide, concluding that the greatest concentration of fish resources at risk may be in streams throughout the Appalachian Plateau and Southern Coastal Plain physiographic provinces (Knapp et al. 1988).

While the MSSCS demonstrated the potential for adverse effects on biota from acidification, little direct information was available from the field on the biological responses of Maryland streams to water chemistry conditions. For this reason, in 1993, DNR created the MBSS to provide comprehensive information on the status of biological resources in Maryland streams and how they are affected by acidic deposition and other cumulative effects of anthropogenic stresses. The MBSS is now eight years old and continues to help environmental decision-makers protect and restore

the natural resources of Maryland. The primary objectives of the MBSS are to

- assess the current status of biological resources in Maryland's non-tidal streams;
- quantify the extent to which acidic deposition has affected or may be affecting biological resources in the state;
- examine which other water chemistry, physical habitat, and land use factors are important in explaining the current status of biological resources in streams;
- provide a statewide inventory of stream biota;
- establish a benchmark for long-term monitoring of trends in these biological resources; and
- target future local-scale assessments and mitigation measures needed to restore degraded biological resources.

To meet these and other objectives of the MBSS, a list of 64 questions that the Survey will try to answer was developed. These questions fall into three categories: (1) characterizing biological resources, physical habitat, and water quality (such as the number of fish in a watershed or the number of stream miles with pH < 5); (2) assessing the condition of these resources (as deviation from minimally impaired expectations); and (3) identifying likely sources of degradation (by delineating relationships between biological conditions and anthropogenic stresses).

Answering these questions has required a progression of steps in the implementation of the Survey, including (1) devising a sampling design to monitor wadeable, non-tidal streams throughout the state and allow area-wide estimates of the extent of the biological resources, (2) implementing sampling protocols and quality assurance/quality control procedures to assure data quality and precision, (3) developing indicators of biological condition so that degradation can be evaluated as a deviation from reference expectations, and (4) using a variety of analytical methods to evaluate the relative contributions of different anthropogenic stresses.

In creating the Survey, DNR implemented a probability-based sampling design as a cost-effective way to characterize statewide stream resources. By randomly selecting sites, the Survey can make quantitative inferences about the characteristics of the more than 10,000 miles of non-tidal streams in Maryland. The EPA is encouraging the use of random sampling designs to assess status and trends in surface water quality (EPA 1993). The Round One MBSS design began with the MSSCS sample frame and was modified during the 1993 pilot and 1994 demonstration phases to provide answers to the questions of greatest interest (Vølstad et al. 1995, 1996). That design allowed robust estimates at the level of stream size (Strahler orders 1, 2, and 3), large watershed (17 river basins), and the entire state. Estimates by other categories, such as counties or smaller watersheds (138 in Maryland), were possible depending on the number of sample points in each unit. Round Two of the MBSS has a slightly different design that allows estimates at the level of smaller watersheds (85 individual or combined Maryland 8-digit watersheds); to achieve the necessary sample density at the same annual level of effort, Round Two will take five years to complete (rather than the three years in Round One).

DNR recognized that the utility of these estimates depended on accurately measuring appropriate attributes of streams. The Survey focuses on biology for two reasons: (1) organisms themselves have direct societal value and (2) biological communities integrate stresses over time and are a valuable and cost-effective means of assessing ecological integrity (i.e., the capacity of a resource to sustain its inherent potential). Inevitably, overall environmental degradation is tied to a failure of the system to support biological processes at a desired level (Karr 1993). It is equally important to recognize that the natural variability in biota requires that several components of the biological system be monitored. Fish are an important component of stream integrity and one that also contributes substantial recreational values. The Survey collects quantitative data for the calculation of population estimates for individual fish species (both game and nongame). These data can also be used to evaluate fish community composition, individual fish health, and the geographic distribution of commercially important, rare, or non-indigenous fish species. Benthic (bottom-dwelling) macroinvertebrates are another essential component of streams and they constitute the second principal focus of the Survey. The Survey uses rapid bioassessment procedures for collecting benthic macroinvertebrates; these semi-quantitative methods permit comparisons of relative abundance and community composition, and have proven to be an effective way of assessing biological integrity in streams (Hilsenhoff 1987, Lenat 1988, Plafkin et al. 1989, Kerans and Karr 1994,

Resh 1995, Barbour et al. 1999). The Survey also records the presence of amphibians and reptiles (herpetofauna), freshwater mussels, and aquatic plants (both submerged aquatic vegetation (SAV) and emergent macrophytes). The Survey has established rigorous protocols (Kazyak 2000) for each of these sampling components, as well as training and auditing procedures to assure that data quality objectives are met.

Although the MBSS sampling design and protocols provide exceptional information for characterizing the stream resources in Maryland, designation of degraded areas and identification of likely stresses requires additional activities. Assessing the condition of biological resources (whether they are degraded or undegraded) requires the development of ecological indicators that permit the comparison of sampled segment results to minimally impacted reference conditions (i.e., the biological community expected in watersheds with little or no human-induced impacts). The Survey has used its growing database of information collected with consistent methods and broad coverage across the state to develop and test indicators of individual biological components (i.e., fish and benthic macroinvertebrates) and physical habitat quality (Roth et al. 2000, Stribling et al. 1998, Hall et al. 1999). These three indices are the basis for estimating the number of stream miles in varying degrees of degradation (good, fair, poor, and very poor condition) and mapping the locations of sites by their condition. Each of these indicators consists of multiple metrics using the general approach developed for the Index of Biotic Integrity (IBI) (Karr et al. 1986, Karr 1991) and the Chesapeake Bay Benthic Restoration Goals (Ranasinghe et al. 1994). The fish and benthic IBIs (which combine attributes of both the number and the type of species found) are widely accepted indicators that have been adapted for use in a variety of geographic locations (Miller et al. 1988, Cairns and Pratt 1993, Simon 1999). The Survey currently reports a composite fish and benthic indicator (Combined Biotic Index, or CBI) and is investigating the possibility of developing additional indicators (e.g., salamanders in small streams with few or no fish).

In addition to using reference-based indicators, the Survey applies a variety of analytical methods to the question of which stresses are most closely associated with degraded streams. This involves correlational and multivariate analyses of water chemistry, physical habitat, land use, and biological information (e.g., presence of non-native species). The biological information also provides an unusual opportunity for evaluating the status of biodiversity across the state; the distribution and abundance of species previously designated as rare only by anecdotal evidence can be determined and unique combinations of species at

the ecosystem and landscape levels can be identified. Land use and other landscape-scale metrics also play an important role in identifying the relative contributions of different stresses to the cumulative impact on stream resources. Ultimately, the Survey seeks to provide an integrated assessment of the problems facing Maryland streams that will facilitate interdisciplinary solutions.

The research progress and assessment results of Round One of the MBSS are reported in Roth et al. (1999) and Boward et al. (1999). Among other findings, Round One collected 83 fish species, including rare occurrences of the endemic checkered sculpin and non-native cutthroat trout. According to the fish IBI, 45% of stream miles fell into the range of good to fair, while 49% fell into this range according to the benthic IBI. Similarly, 49% of stream miles were rated good to fair by the physical habitat index. Statewide, 28% of stream miles were acidic or acid sensitive, indicating a slight improvement since the 1987 MSSCS. Acidic deposition was by far the most common source of stream acidification, dominating 19% of stream miles. Statewide, 59% of stream miles had nitrate-nitrogen concentration greater than 1.0 mg/l, indicating anthropogenic sources. Nearly all sites with greater than 50% urban land use had IBI scores indicative of poor to very poor biological condition. These and other results are already being used by Maryland DNR to target resource management efforts and to reevaluate state designations of rare, threatened, and endangered species. MBSS Round One Results are also being used to support Maryland's Unified Watershed Assessment and other components of the Federal Clean Water Action Plan, the Maryland Tributary Strategy Teams' plans to reduce nutrient contributions to the Chesapeake Bay, and the Maryland Department of the Environment's water quality standards program that lists impaired waters

and develops total maximum daily loads (TMDLs). Round Two of the Survey will continue to contribute to these activities and, by refining the assessment of watershed conditions, may provide even greater utility to managers.

1.2 MBSS IN 2000

2000 was the first year of sampling for Round Two of the Survey. Round Two is a natural extension of the MBSS as it began in 1993 and it includes both (1) a core survey based on statewide sampling of random stream segments and (2) ancillary targeted sampling dedicated to additional monitoring and special studies. The core survey produces the majority of MBSS results and is the focus of this report. The information gathered by the ancillary sampling is included where convenient for completeness, but extensive data analysis of these additional results is reserved for separate reports (but see Chapter 6 on Sentinel Site sampling).

To meet the state's growing need for information at finer spatial scales, Round Two's core survey was redesigned to focus on Maryland's 8-digit watersheds (Table 1-1). The Round Two design was also based on a new 1:100,000-scale base map; this means that more small streams will be sampled than were sampled in Round One. Specifically, Round Two's design allows estimates at the level of 85 individual or combined Maryland 8-digit watersheds by ensuring that each watershed has 10 or more sample sites. To achieve this sample density at the same annual level of effort, Round Two will take five years to complete (rather than the three years in Round One), running from 2000 through 2004. The details of the Round Two study design are presented Section 2.2 of this report.

Table 1-1. Relative sizes of United States Geological Survey (USGS) and Maryland hydrologic units			
	USGS 8-digit Cataloging Unit (MD 6-digit Basin)	MD 8-digit Watershed	MD 12-digit Subwatershed
Number in Maryland	20	138	1066
Average size in Maryland (approx.)	500 sq. mi.	75 sq. mi.	8 sq. mi.

The results of Round Two's core survey will be presented in much the same way as for Round One. Unusual or rare or important species will be included to highlight our improving understanding of the state's biodiversity. The status of sampled watersheds and individual stream segments will be reported, focusing on the conditions ratings of the fish and benthic IBI. Stressor results (for acidification, physical habitat, and nutrients) will be reported within and among watersheds. The 2000 report will also present preliminary comparisons with the Round One data and begin to discuss trends in the condition of Maryland's streams. Individual sites' results for each watershed will be included, with additional information available on a Web-based searchable database at www.dnr.state.md.us/streams. The sampling frame for Round Two is based on a 1:100,000 scale map, and includes a substantial number of streams (primarily first-order) that were not included in the sampling frame used for Round One (1:250,000 map). In the estimation of differences in statewide stream condition between the two rounds, the bias resulting from differences in sampling frames can be corrected for by limiting the analysis to the population of streams that overlaps for the two sampling frames. The difference in map scale is likely to have only a small effect on parameters such as the mean IBI scores because the IBI scoring method is calibrated to adjust for effects of stream size on the expected number of species and other metrics. Results in Vølstad et al. (2001) suggest the mean fish IBI scores for an 8-digit watershed in Montgomery County (Seneca Creek) based on the County survey (1:24,000 map scale) is similar to the mean score based on the MBSS (1:100,000 scale).

While the data obtained from Round Two can still be aggregated to characterize basin or statewide conditions, the new design was intended primarily to provide estimates of stream condition at the smaller watershed level needed by many of the State's watershed assessment and management programs and by local governments. For example, both the State's Unified Watershed Assessment / Clean Water Action Plan and its interim biological criteria framework for non-tidal streams (MDE 2000) employ data to assess and rank Maryland 8-digit watersheds. The interim biocriteria framework for Maryland incorporates stream ratings based on fish and benthic IBIs developed by the MBSS (Roth et al. 2000, Stribling et al. 1998) to identify 8-digit watersheds and 12-digit subwatersheds that are impaired. Results from MBSS 2000 will be used to prepare the State's Clean Water Act 303(d) list and 305(b) water quality report. Our initial analyses of MBSS 2000 data using the interim biocriteria framework are reported in Chapter 7.

Although the Survey will provide the data needed to characterize the status of all 8-digit watersheds (averaging

75 mi² in area), it will not have sufficient sampling density to characterize most of the 1066 smaller 12-digit subwatersheds (averaging 8 mi² in area). Therefore, Round Two of the MBSS has been expanded by DNR to include a new volunteer effort (Maryland Stream Waders) and closer coordination with County stream monitoring programs. Maryland DNR is evaluating the feasibility of integrating data from these other monitoring programs by studying the comparability of each program's sampling and analytical methods. By incorporating these data, the MBSS hopes to characterize many areas of the state at this finer spatial scale.

In 2000, Maryland DNR launched its volunteer Maryland Stream Waders program, primarily using benthic sampling. Each volunteer was trained by Maryland DNR staff in methods documented in the Maryland Stream Waders stream sampling manual (Boward 2000) and quality was assured through 5% duplicate sampling, taxonomic confirmations, and laboratory subsampling. In 2000, volunteers sampled 824 sites within the same watersheds sampled by MBSS crews; 730 of these samples had enough benthic organisms for calculation of a family-level benthic IBI. Stream Wader results will be compiled in a separate report; for further information on Stream Waders, see http://www.dnr.state.md.us/streams/mbss/mbss_volun.html. The goals of the program are to:

- increase the density of sampling sites for use in stream quality assessments;
- improve stream stewardship ethics and encourage local action to improve watershed management;
- educate local communities about the relationship between land use and stream quality; and
- provide quality-assured information on stream quality to state, local, and federal agencies, environmental organizations, and others.

At the same time, Maryland DNR is working with several County (and Baltimore City) stream monitoring programs to coordinate monitoring and assessment efforts. Issues of study design, site selection, comparability of field and laboratory protocols, quality control, and integrated analysis are being addressed as cooperative efforts with the counties. For example, the MBSS and Montgomery County Department of Environmental Protection recently completed a EPA-sponsored case study that outlines general guidelines for integrating state and county programs (Roth et al. 2001).

Currently, the MBSS is also working with the Prince George's County, Howard County, and Baltimore County/City (using Maryland Save Our Streams) programs.

Where feasible, the more spatially intensive monitoring results from the counties will be incorporated into MBSS reporting. It is also likely that both state and county stream monitoring programs will realize cost savings by sharing sampling results.

In addition to improving the spatial intensity of sampling, Round Two will address temporal variability by regular monitoring of fixed “sentinel” sites. In 2000, DNR established a network of sentinel sites deemed to be minimally impacted by human activities. A total of 27 sentinel sites were selected in areas where land uses were unlikely to change over time (e.g., state parklands) from a pool of least-impacted reference sites identified in Round One (i.e., sites meeting designated water chemistry, physical habitat, and land use criteria). Chapter 6 of this report describes sampling efforts at the Sentinel sites.

Ancillary targeted sampling was conducted in 2000 to serve four additional purposes: (1) to provide more data for applying biocriteria in the Lower Monocacy watershed, (2) to collect additional data in coldwater streams to support indicator development for this stream type, (3) to support stream assessment for the Gwynns Falls Long Term Ecological Research (LTER) program, and (4) to provide baseline ecological data from streams that the U.S. Army Corps of Engineers intends to restore. In the Lower Monocacy watershed, the Survey sampled additional sites using the same site selection procedures employed in the core design. The Lower Monocacy had been identified in Round One as one of several watersheds initially categorized as inconclusive and requiring further sampling to support its classification as either impaired or unimpaired. Another 15 coldwater sites were sampled in 2000 to provide additional data from both stressed coldwater streams and healthy coldwater streams that can be used in the future development of a coldwater fish IBI. Two sites were

sampled in the Gwynns Falls watershed during 2000 as part of a long-term monitoring database for the watershed associated with the Baltimore LTER. Lastly, 13 sites were sampled for the U.S. Army Corps of Engineers, including 3 sites in the Anacostia River watershed, 1 site on Big Elk Creek, a site in Henson Creek near the District of Columbia, a site on Mattawoman Creek, and 7 sites in the St. Mary’s River watershed. These data are available from DNR’s website at [www.dnr.state.md.us/ streams](http://www.dnr.state.md.us/streams).

1.3 ROADMAP TO THIS REPORT

This report presents the results of the 2000 annual sampling of Round Two of the MBSS and includes 9 chapters and 2 appendices. Chapter 2 provides a general description of the overall sampling design used in Round Two and describes the specific survey methods used. Chapter 2 also includes a brief description of the field and laboratory protocols and the statistical methods used in data analysis. Chapter 3 provides a comparative assessment of the watersheds sampled in 2000. Separate sections in Chapter 3 focus on biodiversity, biological indicator results, and three predominant issues affecting biological resources: acidification, physical habitat, and nutrients. Chapter 4 summarizes the sampling results for individual watersheds with tabular and map data. Chapter 5 compares the results of the 2000 sampling with Round One (1995-1997) of the Survey. Chapter 6 provides the results of sampling at MBSS sentinel sites. Chapter 7 discusses the application of MBSS 2000 data to the Maryland interim biocriteria framework, indicating which watersheds fail to meet biocriteria thresholds. The conclusions of this report are presented in Chapter 8, focusing on management implications, dominant stressors, and emerging trends. References are in Chapter 9, while summary data tables and weather information are in the Appendices.

2 METHODS

2.1 BACKGROUND

This chapter presents the study design and procedures used to implement Round Two of the Maryland Biological Stream Survey (MBSS or the Survey). Details of the study design and sample frame are included below, along with a summary of landowner permission results and the number of sites sampled in watersheds selected for sampling in 2000. This background material is followed by a summary of field and laboratory methods for each component: water chemistry, benthic macroinvertebrates, fish, amphibians and reptiles, vegetation, and physical habitat. Quality assurance (QA) activities are also described. For further details on Round Two methods, see the MBSS Sampling Manual (Kazyak 2000).

For the most part, methods used in Round Two of the MBSS (2000-2004) are identical to those of Round One (1995-1997). However, some changes were made to improve the quality and/or usefulness of the data generated. These changes in sampling methods include (1) modifications to the physical habitat assessment and characterization, (2) the addition of new chemical analytes (total dissolved nitrogen, total particulate nitrogen, nitrite, ammonia, ortho-phosphate, total dissolved phosphorous, total particulate phosphorous, chloride, and turbidity), (3) collection of continuous in-stream temperature readings at all randomly-selected sample sites throughout the summer, (4) characterization of invasive plant abundance, and (5) the addition of elevation as a physical variable. In addition, the reach file used to select sites is the 1:100,000-scale map developed by USGS; this is a change from the 1:250,000-scale map used in Round One. Another change to the sample frame is the expansion of the Survey to include fourth-order, non-tidal streams.

2.2 STATISTICAL METHODS

2.2.1 Survey Design

The second round of the MBSS will be conducted over five years starting in the year 2000. The Round Two Survey was designed to provide an assessment of stream condition in each of the Maryland 8-digit watersheds that contain non-tidal streams. It also facilitates the assessment of average stream condition over the five-year period for (1) the entire state, (2) the 17 major (Maryland 6-digit) drainage basins,

and (3) other areas of interest such as counties and regions. The design was subject to the following level-of-effort constraints: (1) that a maximum of 300 sites be sampled per year, with approximately 210 allocated to the core random design, and (2) that the maximum sampling interval be 5 years.

2.2.2 Sample Frame

The sample frame for the 2000-2004 MBSS is based on the 1:100,000-scale stream network, a map scale consistent with that used by EPA and other states. The frame was constructed by overlaying the 138 Maryland 8-digit watershed boundaries (Figure 2-1) on a map of all stream reaches in the study area as digitized on a U.S. Geological Survey 1:100,000-scale map. It includes all non-tidal stream reaches of fourth-order and smaller, excluding impoundments that are non-wadeable or that substantially alter the riverine nature of the reach (see Kazyak 1994). Fourth-order streams were included to ensure that the all streams classified as third-order by the 1:250,000 map (and sampled in the 1995-1997 MBSS) are also covered in the 2000-2004 MBSS. Four 8-digit watersheds (Atlantic Ocean, plus the Upper, Middle, and Lower Chesapeake Bay) were excluded from the sample frame because they describe marine/estuarine waters, or do not contain non-tidal streams. Of the 134 watersheds included in the frame, 79 contained less than 100 non-tidal stream miles each; these were combined into 29 "super-watersheds" with between 2 and 7 constituent 8-digit watersheds each. When combined with the 55 remaining "stand alone" watersheds, a total of 84 watersheds of concern were identified as discrete sampling units for the Round Two (Table 2-1).

The Strahler convention (Strahler 1957) was used for identifying stream reaches in each 8-digit watershed by order. First order reaches, for example, are the most upstream reaches in the branching stream system. The designation of stream order for a particular reach depends on the scale and accuracy of the map.

2.2.3 Sample Selection

The second round of MBSS was restricted to a maximum of 300 sampling sites per year (210 within the core survey). Hence, it was not practical to stratify the network of streams in Maryland by 8-digit watersheds and sample them

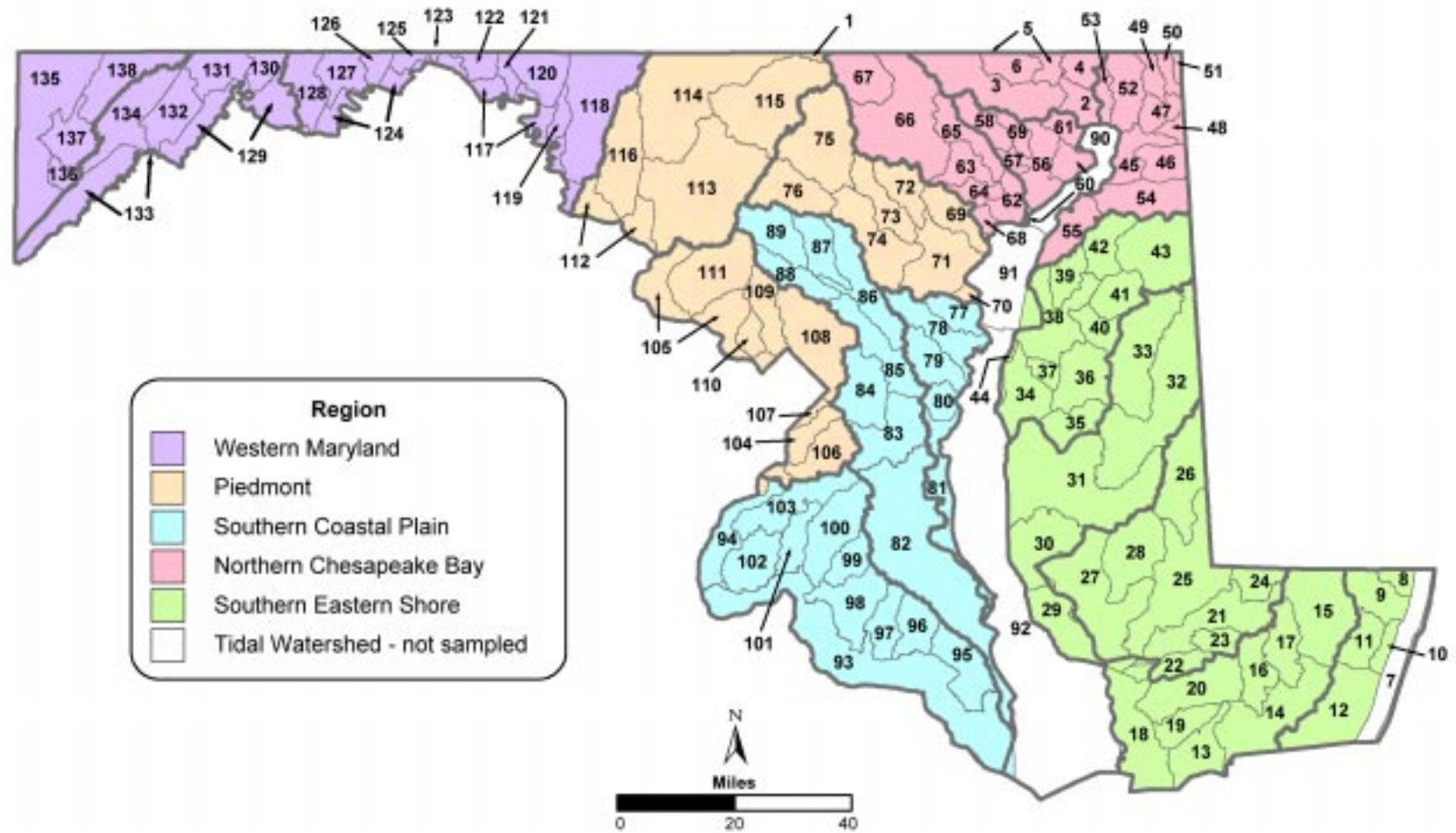


Figure 2-1. Maryland 8-digit watersheds by region

Table 2-1. Maryland individual and combined watersheds (primary sampling units or PSUs) to be sampled in the 2000-2004 MBSS.

* indicates watershed selected that year for repeated sampling

Basin	Watershed	Watershed Number	2000	2001	2002	2003	2004	Extra Sites
Youghiogheny	Youghiogheny River	135		X				6
	Little Youghiogheny/Deep Creek Lake	136/137					X	
	Casselman River	138	X					
North Branch Potomac	Potomac River Lower North Branch	129				X		5
	Evitts Creek	130					X	
	Wills Creek	131					X	
	Georges Creek	132				X		
	Potomac River Upper North Branch	133		X				
	Savage River	134			X			4
Upper Potomac	Antietam Creek	118				X		4
	Potomac WA Co/Marsh Run/Tonoloway/Little Tonoloway	117/119/123/125	X		*			3
	Conococheague	120			X			
	Little Conococheague/Licking Creek	121/122					X	
	Potomac AL Co/Sideling Hill Creek	124/126		X				
	Fifteen Mile Creek	127	X					
	Town Creek	128	*		X			
Middle Potomac	Potomac River FR Co	112					X	
	Lower Monocacy River	113				X		11
	Upper Monocacy River	114	X					8
	Conewago Creek/Double Pipe Creek	1/115			X			7
	Catoctin Creek	116				X		4
Potomac Wash Metro	Potomac River MO Co	105			X			5
	Piscataway Creek	106		X				
	Potomac Upper Tidal/Oxon Creek	104/107		X				
	Anacostia River	108					X	5
	Rock Creek/Cabin John Creek	109/110				X		
	Seneca Creek	111		X				5

Table 2-1. (Continued)								
Basin	Watershed	Watershed Number	2000	2001	2002	2003	2004	Extra Sites
Patapsco	Back River	69			X			
	Bodkin Creek/Baltimore Harbor	70/71		X			*	
	Jones Falls	72			X			
	Gwynns Falls	73					X	
	Patapsco River Lower North Branch	74	X					4
	Liberty Reservoir	75	X			*		5
	South Branch Patapsco	76	X					
Patuxent	Little Patuxent River	86	X					3
	Middle Patuxent River	87			X			
	Rocky Gorge Dam	88			X			
	Brighton Dam	89	X					
	Patuxent River Lower	82					X	8
	Patuxent River Middle	83		X				3
	Western Branch	84		X				
	Patuxent River Upper	85					X	
Lower Potomac	Breton/St. Clements Bays	96/97			X			
	Potomac Lower Tidal/Potomac Middle Tidal	93/94			*		X	
	St. Mary's River	95	*			X		
	Wicomico River	98					X	
	Gilbert Swamp	99		X				
	Zekiah Swamp	100		X				3
	Port Tobacco River	101				X		
	Nanjemoy Creek	102	X					
	Mattawoman Creek	103	X					
West Chesapeake	Magothy River/Severn River	77/78				X		
	South River/West River	79/80			X			
	West Chesapeake Bay	81				X		
Gunpowder	Gunpowder River/Lower Gunpowder Falls/Bird River/ Middle River-Browns	62/63/64/68			X			
	Little Gunpowder Falls	65		*		X		
	Loch Raven Reservoir	66			X			7
	Prettyboy Reservoir	67	X					

Table 2-1. (Continued)								
Basin	Watershed	Watershed Number	2000	2001	2002	2003	2004	Extra Sites
Susquehanna	Lower Susquehanna/Octoraro Creek/Conowingo Dam Susquehanna	2/4/5					X	
	Deer Creek	3		X			*	4
	Broad Creek	6				X		
Bush	Aberdeen Proving Ground/Swan Creek	60/61	X					
	Lower Winters Run/Atkisson Reservoir	57/58					X	
	Bush River/Bynum Run	56/59					X	
Elk	Northeast River/Furnace Bay	52/53		X				
	Lower Elk River/Bohemia River/Upper Elk River/Back Creek/Little Elk Creek/Big Elk Creek/Christina River	45/46/47/48/49/50/51				X		
	Sassafras River/Stillpond-Fairlee	54/55		X				
Chester	Eastern Bay/Kent Narrows/Lower Chester River/ Langford Creek/Kent Island Bay	34/37/38/39/44			X			
	Miles River/Wye River	35/36				X		
	Corsica River/Southeast Creek	40/41	X					
	Middle Chester River	42			X	*		
	Upper Chester River	43					X	
Choptank	Honga River/Little Choptank/Lower Choptank	29/30/31				X		
	Upper Choptank	32	X					
	Tuckahoe Creek	33				X		
Nanticoke/Wicomico	Lower Wicomico/Monie Bay/Wicomico Creek/Wicomico River Head	21/22/23/24	X					
	Nanticoke River	25		*	X			
	Marshyhope Creek	26					X	
	Fishing Bay/Transquaking River	27/28					X	
Pocomoke	Pocomoke Sound/Tangier Sound/Big Annemessex/Manokin River	13/18/19/20				X		
	Lower Pocomoke River	14			X			
	Upper Pocomoke River	15		X				3
	Dividing Creek/Nassawango Creek	16/17		X				
Ocean Coastal	Assawoman/Isle of Wight/Sinepuxent/Newport/Chincoteague Bays	8/9/10/11/12		X				

annually (i.e., only 2 sites could be sampled in each of the 134 watersheds each year under that design, resulting in unreliable estimates at the 8-digit watershed scale). In addition, the costs of traveling to sample each watershed each year would be high, resulting in fewer than 210 sites being sampled annually. As an alternative to stratifying by watershed, the Survey designated the 84 watershed units of concern (both 55 single watershed units and 29 super-watersheds) as primary sampling units (PSUs). A subset of the 84 PSUs will be selected randomly each year, with restrictions to ensure that all 8-digit watersheds are sampled once during the five-year sampling period. Using this approach, a representative sub-set of watersheds can be studied each year, covering all the 84 watersheds of concern over a five-year period.

2.2.3.1 Lattice Sampling of Watersheds (PSUs)

Lattice sampling was used to schedule the sampling of all 84 watersheds (PSUs) over a 5-year period (see Cochran 1977; Jessen 1978). A sampling frame for selecting watersheds across time was formed by arranging the PSUs into a lattice with 84 rows and one column for each year (Table 2-1).

The 84 PSUs were stratified into five physiographic regions (strata) to ensure that their sampling is spread out geographically during each sample year (Figure 2-2). These five regions include whole major (Maryland 6-digit) drainage basins and divide the State into approximately equal parts. This stratification by region was done to spread out the sampling in space and thereby increase precision in statewide estimates; the geographic strata are not considered important reporting units.

A first-stage random sample of PSUs is drawn from each region in each year, with restrictions to ensure that all 84 watersheds (PSUs) of concern are sampled at least once during the 5-year sampling period. The lattice sampling supports an estimate of average statewide condition over the 5-year period. This strategy is similar to the lattice design used in the 1994 Demonstration Study (Vølstad et al. 1996) and the 1995-1997 MBSS Round One design (Roth et al. 1997); it takes into account the restrictions in annual sampling effort. About one-fifth of the watersheds in each of the five regions are randomly selected (without replacement) each year. In addition, two randomly selected watersheds in each region will be sampled twice during the five-year Survey (in randomly selected years). The representative sampling over time, augmented by repeated sampling of watersheds, ensures that all PSUs and pairs of

PSU combinations have a known probability (greater than zero) of being selected. This probability-based sampling facilitates the estimation of statewide average condition over the 5-year study period with quantifiable precision based on the Horvitz-Thompson estimator (Horvitz and Thompson 1952; Thompson 1992). It also allows estimation of statewide conditions for each year of the Survey.

2.2.3.2 Stratified random sampling within PSUs

Within each PSU, the elementary sampling units from which field data are collected (i.e., the 75-m stream segments or sites) are selected using either stratified random sampling with proportional allocation, or simple random sampling (Cochran 1977). This allocation ensures that all sites in a PSU stream network have the same probability of being selected. The target sample size in each PSU is a minimum of 10 sites for the spring benthic sampling. Because of imperfections in the sample frame, a list of random replacement sites is provided for each PSU.

When the Round Two design was proposed, the target minimum of 10 sites per PSU was determined by analyzing the expected variability in IBI mean scores and percentage stream mile estimates as a function of varying sample size. Analysis (as presented in Southerland et al. 2000) indicated that fewer than 10 sites per PSU would not yield sufficient precision in stream mile estimates. Working with DNR, the survey designers determined that 10 sites per watershed would yield an acceptable level of precision while remaining within other design constraints (i.e., the annual level of effort available for sampling and the maximum sampling interval of five years for the statewide survey).

When feasible, the streams in each of the 55 PSUs consisting of a single 8-digit watershed were grouped into two strata based on stream order. One stratum includes all the first- and second-order streams, while the other includes all the third- and fourth-order streams. The number of sites in each of the two strata are allocated proportional to their stream length, resulting in equal sampling density for the two strata. In watersheds where the proportion of stream miles in one stratum (e.g., third- and fourth-order streams) is significantly below 10%, the stringent proportional allocation could not be achieved because it would result in allocation of less than one sample site to this stratum. Samples were not forced into strata that contained a minimal portion of stream miles, because this would eliminate the simplicity of equal probability sampling. Instead, the strata for such PSUs were collapsed, and a simple random sample of sites from all streams was selected.

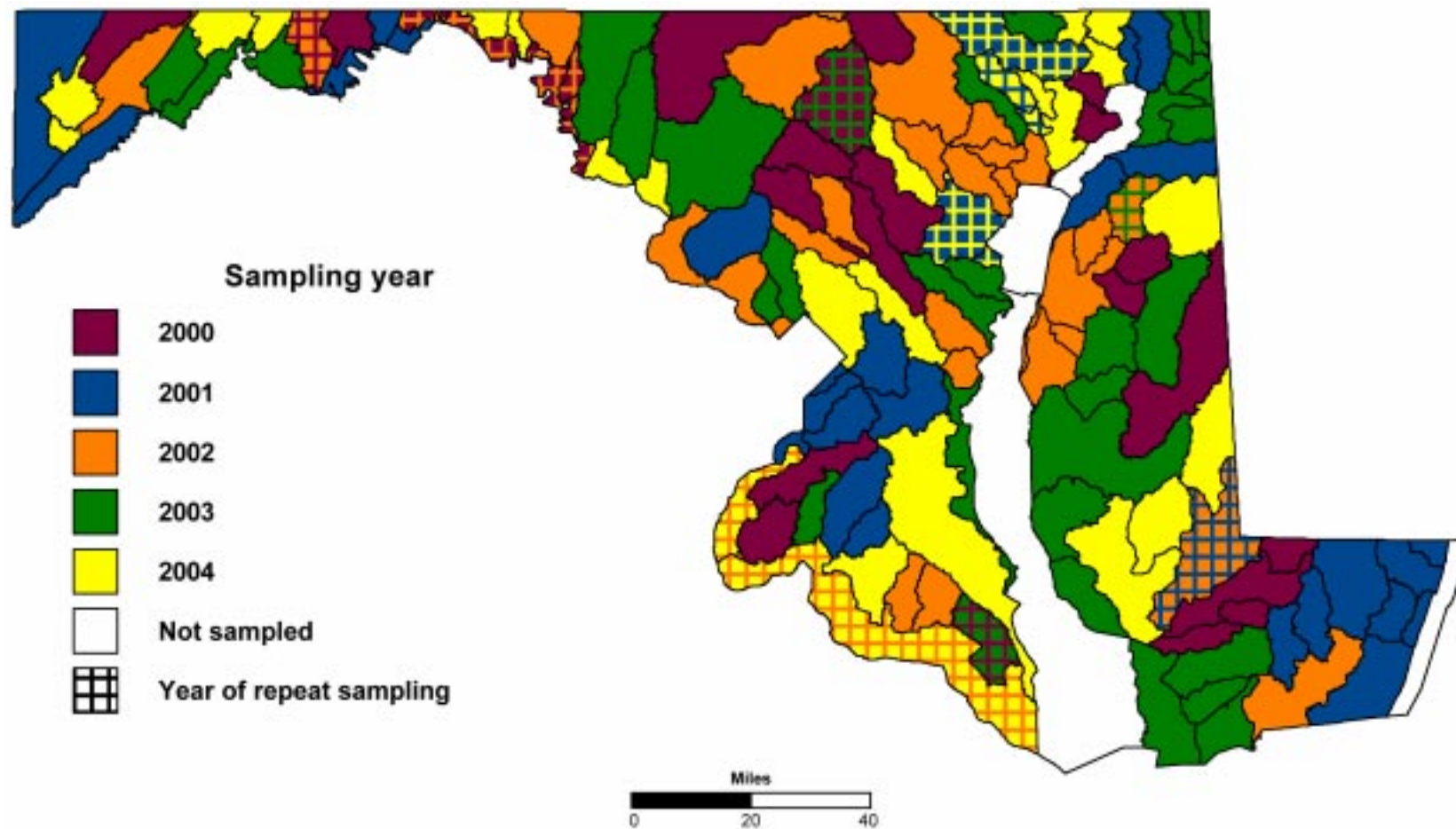


Figure 2-2. MBSS 2000-2004 Primary Sampling Units (PSUs) and sampling schedule

A different stratification was used for the 29 PSUs consisting of more than one 8-digit watershed (i.e., the super-watersheds). For these PSUs, each constituent 8-digit watershed was designated a stratum, and the strata receive equal sampling fractions (i.e., proportional to stream miles in each 8-digit watershed). This stratification of super-watersheds was done to ensure that the non-tidal streams in each individual 8-digit watershed were sampled. While this approach may increase precision of stratified estimates for the super-watershed, the precision in estimates for individual 8-digit watersheds will generally be low because of low sample sizes. The limited sample sizes allocated to each PSU did not allow further stratification of the super-watersheds by stream order.

When one or more of the initial sample of stream segments in a PSU could not be sampled (e.g., dry stream or no permission to access), the stratification of the PSU was

abandoned, and the replacement sites were selected from a list of simple random sites. This adjustment was made because the fraction of unsampleable sites cannot be adequately quantified for individual strata with low sample sizes.

2.2.3.3 Allocation of Additional Sites to Large Watersheds

Additional sites were allocated to 22 watersheds with more than 100 non-tidal stream miles. Increased sample sizes in these watersheds will reduce the variance of key estimates and improve statewide estimates (by more closely approximating statewide allocation proportional to stream miles). Over the five-year Survey, a total of 106 additional sites were allocated proportional to stream miles within these large watersheds (Table 2-2).

Table 2-2. List of MBSS Round Two Primary Sampling Units with greater than 100 non-tidal stream miles, scheduled for additional sample sites

Primary Sampling Unit	Number of Stream Miles	Number of Additional Sites
Lower Monocacy River	388.39	11
Upper Monocacy River	284.38	8
Patuxent River Lower	280.90	8
Loch Raven Reservoir	237.10	7
Conewago Creek/Double Pipe Creek	231.16	7
Youghiogheny River	222.56	6
Liberty Reservoir	184.08	5
Seneca Creek	178.85	5
Potomac River Lower North Branch	165.45	5
Potomac River MO Co	160.68	5
Anacostia River	159.34	5
Antietam Creek	146.34	4
Deer Creek	142.62	4
Patapsco River Lower North Branch	129.50	4
Catoctin Creek	128.95	4
Savage River	127.13	4
Upper Choptank	127.02	4
Little Patuxent River	122.48	3
Zekiah Swamp	120.75	3
Potomac WA Co/Marsh Run/Tonoloway/Little Tonoloway	118.43	3
Patuxent River Middle	111.19	3
Upper Pocomoke River	109.65	3

2.2.4 Site Selection

- **Sample Frame Construction.** The stream order of each reach was attributed on the 1:100,000-scale USGS Digital Line Graph (DLG) maps. If necessary, 1:24,000-scale USGS topographic maps were used as references to identify flow patterns or to see more detail. Where necessary, maps from Pennsylvania and Delaware were used to identify the stream order of water bodies originating outside of Maryland.
- **Random Site Picks.** Once the sample frame was developed for a PSU, sites were randomly assigned according to the stratified design described above using a FORTRAN-based program. If the proportion of stream miles in the smallest strata (either stream-order-based in single watershed PSUs or watershed-based in the super-watersheds) was greater than or equal to 10%, sites were allocated proportionally among strata; if it was less than 10%, the strata were collapsed and sites allocated by simple random sampling. After the target number of sites was selected (10 to 21 sites depending on PSU size), a simple random selection of “extra sites” to a total of 50 was chosen in each PSU using the GIS. This was done to ensure that a sufficient number of sites remained available for sampling after permission denials and unsampleable sites were removed from consideration.

Each sample point chosen on the GIS was designated as the midpoint of the 75-m sampling segment in the field. Sites selected less than 75 meters from a previous site (both upstream and downstream) were eliminated. Sites that could possibly cross stream network nodes were not eliminated from the program; it was assumed that these sites could be adjusted in the field by moving the starting point away from the node, but staying within the designated stream order.

Each site was then attributed with the following information:

- stream order
- county
- basin
- physiographic region
- northing, easting
- latitude and longitude (both in decimal degrees and in degrees, minutes, seconds)
- watershed name and MD 8-digit watershed code

2.2.5 Permissions from Landowners

- **Extra Permissions.** Permission was solicited to sample from landowners at twice the number of sites allocated to each PSU by the design (usually 20 sites, but from 26 to 42 in the larger watersheds). While the allocated number of sites (usually 10) were selected from the appropriate strata (see above), the “extra sites” were chosen to fill out the list, regardless of stream order. At the completion of site selection for each county, sites were sent to DNR, so that they could generate 1:24,000-scale topographic maps and transmit the sites to local governments planning stream monitoring.
- **Landowner Identification.** Each site was plotted on county tax maps using the Maryland Office of Planning Maryland Property View System obtained from DNR. From this, property owners could be identified, both for the site containing the point and for any areas required to access the stream. Phone numbers were obtained from the internet using a white pages directory (<http://www.switchboard.com>).
- **Landowner Contact.** If the phone number was unlisted, a letter was prepared requesting permission to access the property, including a written form and telephone contact information through which the landowner could respond. The letter also provided a MBSS brochure and telephone number to call for more information. If the number was listed, the property owner was called and permission to access the site was requested. After 2-3 calls and no success, a letter was sent. If the owner did give permission, the caller found out additional information about the site, such as whether the stream was often dry or hard to access. The caller also recorded whether the crew needed to make a pre-visit call to the landowner or whether the owner had to be available to open gates or walk the crew through the property. All property owner information was entered and maintained in a Microsoft Access database.
- **Field Crew Information.** Permission packets were then prepared for the field crews. Packets contained a printout of the property owner information for each site and a tax map showing possible access routes. The callers attempted to obtain permissions for the target sites in the proportions that stream orders occur in each PSU. In addition, permissions were obtained for extra sites (up to 50% more than the targeted

number) to account for non-sampleable sites. These extra sites represent a simple random sample and may or may not be of the same stream order as the originally selected sites (for example, if a third- to fourth-order site was unsampleable, the replacement site was the next on the simple random list, regardless of stream order).

2.3 ANALYTICAL METHODS

2.3.1 Estimation of Means, Proportions and Totals Within Watersheds (PSUs)

The sampling design within watersheds (PSUs) involves simple random sampling, or stratified random sampling with proportional allocation of sites across the L strata. Standard PSUs have two strata based on stream order, while the strata in “super-watersheds” consist of the constituent 8-digit watersheds (Table 2-3).

Table 2-3. The following symbols refer to the population of streams and the sample of sites.		
Population	Sample	Defined as
N_r	n_r	Number of watersheds (PSUs) in region r
M_{rih}	m_{rih}	Number of 75-m sites in strata h within PSU i in region r . A standard PSU has two strata: (1) 1 st - 2 nd order streams; and (2) 3 rd - 4 th order streams. For super-watersheds, the number of strata is equal to the number of 8-digit watersheds within the PSU.
Y_{rihj}	y_{rihj}	Variable of interest associated with site j , $j=1,2,\dots,m_{rih}$

For simplicity the subscript r for region in the estimators for watersheds was not included. For PSUs with collapsed strata, estimates of means, totals, and proportions are based on the standard estimators for simple random sampling (Cochran 1977).

For PSUs where stratification could be achieved, stratified estimators were used. Suppose m_{ih} sites are chosen ran-

domly in stratum h , within watershed i , and, at each site j , measurements are collected for the variable of interest y_{ihj} . Standard stratified estimators (Cochran 1977) are used to estimate means, proportions, and totals when all randomly selected sites in watershed i are sampleable, and the number of stream miles can be determined directly from the sample frame. An estimator for the mean of the variable of interest y is

$$\bar{y}_i = \sum_{h=1}^L w_h \bar{y}_h$$

where

$$\bar{y}_h = \frac{1}{m_{ih}} \sum_{j=1}^{m_{ih}} y_{ijk}$$

is the mean of y for watershed i within stratum h and w_h is the proportion of stream miles in the stratum (determined from the sample frame). The variance of the stratified mean for y in watershed i is

$$Var(\bar{y}_i) = \sum_{h=1}^L w_h^2 \frac{s_{ih}^2}{m_{ih}}$$

where

$$s_{ih}^2 = \frac{1}{m_{ih}} \sum_{j=1}^{m_{ih}} y_{ihj}^2$$

is the sample variance for the variable of interest in stratum h for watershed i . An estimator for the standard error of \bar{y}_i is

$$\sqrt{Var(\bar{y}_i)}.$$

The same estimators can be used to estimate proportions of stream miles in a specific class by introducing an indicator variable that takes the value 1 when the variable y meets the condition (e.g., $pH < 6$), and zero otherwise. The mean of this indicator using the estimators above is an estimate of the proportion of stream miles within the specific class (e.g., proportion of stream miles with $pH < 6$). When estimating proportions (e.g., proportion of stream miles with $pH < 6$) within watersheds, the samples can be treated as repeated

independent samples of binary observations (1 if pH < 6, and 0 otherwise). An exact confidence interval for an estimated proportion (p) is obtained from the binomial distribution (Collett 1999, pp. 23-24), with lower and upper confidence bounds

$$p_L = y[y + (n - y + 1)F_{2(n-y+1), 2y}(\alpha/2)]^{-1}$$

$$p_U = (y+1)[y+1+(n-y)F_{2(y+1), 2(n-y)}(\alpha/2)]^{-1}$$

respectively, where $F_{v_1, v_2}(\alpha/2)$ is the upper $(100\alpha/2)\%$ point in the F-distribution with v_1 and v_2 degrees of freedom, and y is the observed number of successes (e.g., number of sites with IBI < 3) out of the n observations in a watershed.

An estimator for the total of a variable of interest (e.g., number of fish) in a watershed i is obtained by extrapolating the mean to all stream miles

$$\hat{Y}_i = M_i \bar{y}_i$$

with standard error

$$M_i \sqrt{\text{Var}(\bar{y}_i)}.$$

In practice some of the random sites m_{ih} selected in a watershed i may fall outside the defined target streams for MBSS. During periods of drought, for example, sections of streams represented on the 1:100,000-scale map used in MBSS may not exist. Also, because of imperfections in the sample frame, some selected sites may fall outside the actual network of target streams defined by MBSS. Loss of samples was anticipated in the MBSS, and a list of randomly selected replacement sites was provided for the sampling crews. For the MBSS, estimates are made for the target streams, which may be a subpopulation of streams within an imperfect sample frame. This subpopulation is referred to as a *domain of study* (U.N. Subcommittee on Sampling 1950).

For the MBSS, unsampleable streams are outside the domain of study. In this case, the Survey is interested in estimating parameters for the domain of study, i.e., for “MBSS target streams.” All samples in watershed i can be treated as a simple random sample of size m_i , because samples were allocated to strata proportional to their stream length. This assumption is reasonable because the sampling

fractions in the strata are equal, and each stream site has the same probability of being selected. Let the domain of study (MBSS target streams) in watershed i contain M'_{di} stream miles, and let m'_i be the number of sites of the simple random sample of size m_i that happens to fall in this domain. If y'_k ($k=1, 2, \dots, m'_i$) are the measurements of the variable of interest from these sites, the mean for domain d is estimated by

$$\bar{y}_{id} = \sum_{k=1}^{m'_i} \frac{y'_k}{m'_i}$$

and an estimate for the standard error of \bar{y}_{id} is

$$\frac{s_{id}}{\sqrt{m'_i}}$$

where

$$s_{id}^2 = \sum_{k=1}^{m'_i} \frac{(y'_k - \bar{y}_{id})^2}{m'_i - 1}$$

The finite population correction factor can safely be ignored because the sampling fraction (i.e., the number of 75-m segments sampled relative to all available) within each watershed is small.

2.3.2 Estimation of Statewide Means, Proportions, and Totals Within a Year

Each year, a random sample of watersheds (PSUs) is selected (without replacement) in each of five strata (regions) (Table 2-1). Because of the representative selection of watersheds, the survey supports yearly statewide estimates of stream condition. Let n_r denote the sample size in region r and let \bar{y}_{idr} be the mean of the variable of interest in the domain of study for watershed i in region r . A combined ratio estimator is used to estimate the statewide mean

$$\bar{y}_{st} = \sum_{r=1}^5 \frac{w_r \bar{y}_{rd}}{w_r \bar{M}_{rd}}$$

where for the r^{th} region w_r is the proportion of watersheds (PSUs) in the region, \bar{y}_{rd} is the average y per watershed,

and \bar{M}_{rd} is the average number of stream miles in domain d per watershed. This complex estimator for the statewide mean of y is necessary because the proportion of stream miles in the domain of study in each region is unknown. The standard error of the statewide mean is estimated in accordance with the survey design, using SUDAAN (Shah et al. 1997). SUDAAN is a survey analyses software package that runs under SAS. Estimates of stream condition based on samples from multiple years (including repeat sampling of watersheds) will be based on the Horvitz-Thompson estimator (Horvitz and Thompson 1952). The data analyses for MBSS 2000-2004 are conducted using SAS and SUDAAN. SUDAAN has routines for analyses of complex surveys.

segment. For 2000, the success rate for obtaining permissions was 67% (Table 2-4). Cases where permissions were not obtained included both denials (8%) as well as non-responses (25%), when landowners were unable to be reached and did not respond to letters and telephone messages. Reasons for permission denial varied widely and generally reflected the preferences of individual landowners regarding property access, rather than any specific types of land. In rare cases, permission denial may affect the interpretation of MBSS estimates, but only where denials occur in streams with characteristics that differ from the general population of streams. During 2000 sampling, it did not appear that permission denials affected MBSS estimates.

2.4 LANDOWNER PERMISSION RESULTS

As discussed in Section 2.2.5, permissions were obtained to access privately owned land adjacent to or near each stream

PSU	Number of Stream Segments Targeted as Potential Sample Sites	Success Rate	No Response
Casselman River	26	69%	31%
Town Creek	20	80%	15%
Fifteen Mile Creek	20	90%	10%
Potomac River WA Co/Marsh Run/Tonoloway/ Little Tonoloway	24	84%	16%
Upper Monocacy River	34	64%	25%
Mattawoman Creek	18	61%	33%
Nanjemoy Creek	20	55%	45%
St. Mary's River	18	72%	17%
Brighton Dam	26	62%	26%
Little Patuxent River	26	81%	18%
South Branch Patapsco River	22	60%	32%
Liberty Reservoir	30	83%	7%
Patapsco River Lower North Branch	28	71%	25%
Prettyboy Reservoir	24	63%	25%
Aberdeen Proving Ground/Swan Creek	20	65%	15%
Corsica River/Southeast Creek	20	74%	16%
Upper Choptank	26	54%	23%
Lower Wicomico River/Monie Bay/Wicomico Creek/Wicomico River Head	25	56%	32%
TOTAL	474	67%	25%

2.5 NUMBER OF SITES SAMPLED IN 2000

As stated in Section 2.2.3.2 above, the target sample size in each PSU is a minimum of 10 sites for the spring benthic sampling. Additional sites were allocated to the larger PSUs sampled in 2000: Upper Monocacy River (8 extra), Liberty Reservoir (5 extra), Patapsco River Lower North Branch (4 extra), Upper Choptank (4 extra), Little Patuxent River (3 extra), Potomac WA Co/ Marsh Run/ Tonoloway/ Little Tonoloway (3 extra). Table 2-5 lists the number of sites sampled for spring benthic, physical habitat, and water chemistry sampling. For each PSU, the number of sites actually sampled equaled or exceeded the target number specified in the design. Fifteen sites were unsampleable in

the spring for a variety of reasons, including beavers and tidal influence. Note that in both St. Mary's River and Patapsco River Lower North Branch, one site was deemed unsampleable for benthos, but water quality and habitat measurements were made.

During summer sampling, a small number of sites that had been sampled in the spring were unsampleable for several reasons, the most common being that the stream had dried up. Table 2-6 lists the number of sites that were electro-fished during the summer of 2000. It also lists the number of sites where summer habitat and water quality measures were taken, as well as the number of sites where amphibians and reptiles, mussels, and aquatic vegetation were qualitatively sampled.

Table 2-5. Number of sites sampleable in the spring for MBSS 2000 PSUs.				
PSU	Number of Unsampleable Sites	Number of Benthic Sites	Number of Spring Habitat Sites	Number of Spring Water Quality Sites
Casselman River	0	10	10	10
Town Creek	0	10	10	10
Fifteen Mile Creek	0	10	10	10
Potomac River WA Co/Marsh Run/Tonoloway/ Little Tonoloway	3	13	13	13
Upper Monocacy River	3	18	18	18
Mattawoman Creek	0	11	11	11
Nanjemoy Creek	1	10	10	10
St. Mary's River	1	10	11	11
Brighton Dam	0	11	11	11
Little Patuxent River	1	13	13	13
South Branch Patapsco River	1	10	10	10
Liberty Reservoir	0	16	16	16
Patapsco River Lower North Branch	2	14	15	15
Prettyboy Reservoir	0	10	10	10
Aberdeen Proving Ground/Swan Creek	2	11	11	11
Corsica River/Southeast Creek	0	10	10	10
Upper Choptank	0	14	14	14
Lower Wicomico River/Monie Bay/Wicomico Creek/ Wicomico River Head	1	10	10	10
TOTAL	15	211	213	213

Table 2-6. Number of sites sampleable in the summer for MBSS 2000 PSUs.						
PSU	Number of Sites Fished	Number of Summer Habitat Sites	Number of Summer Water Quality Sites	Number of Sites - Amphibians and Reptiles	Number of Sites - Mussels	Number of Sites - SAV
Casselman River	10	10	10	10	10	10
Town Creek	8	8	8	9	8	8
Fifteen Mile Creek	8	8	8	10	8	8
Potomac River WA Co/Marsh Run/Tonoloway/ Little Tonoloway	12	12	12	13	12	12
Upper Monocacy River	17	17	17	18	17	17
Mattawoman Creek	10	10	10	10	10	10
Nanjemoy Creek	10	10	10	10	10	10
St. Mary's River	9	9	9	10	9	9
Brighton Dam	11	11	11	11	11	11
Little Patuxent River	13	13	13	13	13	13
South Branch Patapsco River	10	10	10	10	10	10
Liberty Reservoir	16	16	16	16	16	16
Patapsco River Lower North Branch	13	13	13	14	13	13
Prettyboy Reservoir	10	10	10	10	10	10
Aberdeen Proving Ground/Swan Creek	9	9	9	10	9	9
Corsica River/Southeast Creek	10	10	10	10	10	10
Upper Choptank	13	13	14	14	14	14
Lower Wicomico River/Monie Bay/Wicomico Creek/Wicomico River Head	10	10	10	10	10	10
TOTAL	199	199	200	208	200	200

2.6 FIELD AND LABORATORY METHODS

2.6.1 Spring and Summer Index Periods

Benthic macroinvertebrate and water quality sampling were conducted in spring, when acidic deposition effects are often the most pronounced. While it is recognized that several different index periods may be used for benthic sampling, the MBSS chose the spring index period for logistical purposes. Fish, amphibian, reptile, and aquatic vegetation surveys, along with physical habitat evaluations, were conducted during the low-flow period in summer. Fish community composition tends to be stable during summer, and low flow is advantageous for electrofishing. Because low-flow conditions in summer may be a primary factor limiting the abundance and distribution of fish populations, habitat assessments were performed during the summer.

To reduce temporal variability, sampling was conducted within specific, relatively narrow time intervals, referred to as index periods. The spring index period was defined by degree-day limits for specific parts of the state. The spring index period was between March 1 and about May 1, with the end of the index period determined by degree-day accumulation as specified in Hilsenhoff (1987). In reality, all spring samples were collected in March, well before degree-day accumulation limits were approached. The targeted summer index period was between June 1 and September 30 (Kazyak 2000). In 2000, summer index period sampling ran into the beginning of October, because frequent rain events earlier in summer had kept larger streams from being clear enough to electrofish. While the spring index period is two months in duration because of changing weather conditions (possible rapid warming leading to changes in stream condition), the summer index period is four months long because weather conditions are more consistent throughout the season and fish sampling is more time consuming.

2.6.2 Water Chemistry

During the spring index period, water samples were collected at each site for analysis of water quality conditions, with an emphasis on factors related to acidic deposition and nutrients (Table 2-7). Grab samples were collected in 0.5 and 1-liter bottles for analysis of all analytes except pH. Water samples for pH were collected with 60 ml syringes, which allowed purging of air bubbles to minimize changes in carbon dioxide content (EPA 1987). Samples were stored on wet ice and shipped on wet ice to the analytical laboratory within 48 hours. The requirement to filter for some analytes within 24 hours was exceeded by several hours for some samples. Laboratory analyses were carried out by the University of Maryland's Appalachian Laboratory in Frostburg.

Chemical analysis of water samples followed standard methods as listed in Table 2-7. Routine daily quality control (QC) checks included processing duplicate, blank, and calibration samples according to EPA guidelines for each analyte. Field duplicates were taken at 5% of all sites. Routine QC checks helped to identify and correct errors in sampling routines or instrumentation at the earliest possible stage. Standard operating procedures were implemented that detail the requirements for the correct performance of analytical procedures. The internal QA/QC protocols followed guidelines outlined in EPA (1987). The complete QA/QC report for 2000 MBSS sampling can be found in Kline and Morgan (2001). QC results were examined in conjunction with site data and are summarized in a separate report (Mercurio et al. 2001).

During the summer index period, in situ measurements of dissolved oxygen (DO), pH, temperature, and conductivity were collected at each site to further characterize existing water quality conditions that might influence biological communities. Measurements were made at an undisturbed section of the segment, usually in the middle of the stream channel and at the upstream segment boundary, using electrode probes. Instruments were calibrated daily and calibration logbooks were maintained to document instrument performance. In 2000, there were no quality assurance problems apparent in log books and other documentation (Mercurio et al. 2001).

2.6.3 Benthic Macroinvertebrates

Benthic macroinvertebrates were collected to provide a qualitative description of the community composition at

each sampling site. Sampling was conducted during the spring index period. Benthic community data were collected primarily for the purpose of calculating DNR's Benthic Index of Biotic Integrity (BIBI) for Maryland streams (Stribling et al. 1998). Recognizing that Maryland streams vary from high-gradient riffle habitat with abundant cobble substrate to low-gradient Coastal Plain streams with sandy or silty bottoms, MBSS employs a "D" net suitable for sampling a wide variety of habitats. This multi-habitat approach is consistent with the recommendations of the Mid-Atlantic Coastal Streams Workgroup (MACS 1996) and the EPA's most recent Rapid Bioassessment Protocols (Barbour et al. 1999).

At each segment, a 600-micron mesh "D" net was used to collect organisms from habitats likely to support the greatest taxonomic diversity. This habitat often includes a riffle area when present. Other habitats, in order of preference, include gravel, broken peat, or clay lumps in a run area; snags or logs that create a partial dam or are in run habitat; undercut banks and associated root mats; and SAV and detrital/sand areas in moving water. In riffles and most other habitats, sampling involved placing the net downstream, gently rubbing surficial substrates by hand to dislodge organisms, and disrupting deeper substrates using vigorous foot action. Each dip of the net covered one-two square feet, and a total of approximately 2.0 m² (20 square feet) of combined substrates was sampled; samples were preserved in 70% ethanol. Duplicate benthic samples were taken at 13 MBSS sites in order to assess the replicability of the field methods.

In the laboratory, the preserved sample was transferred to a gridded pan and organisms were picked from randomly selected grid cells until the cell that contained the 100th individual (if possible) was completely picked. Some samples had fewer than 100 individuals. The benthic macroinvertebrates were identified to genus, or lowest practicable taxon, in the laboratory. To aid in identification, oligochaete and chironomid taxa were slide-mounted and identified under a microscope. Laboratory QC procedures included the re-subsampling and identification of every 20th sample. This second sample was identified according to standard procedures and comparisons were made between the two duplicates. For the 2000 sampling year 16 sites were re-sampled for QC purposes. The MBSS voucher specimen collection is currently maintained at the Maryland DNR Field Office in Annapolis, Maryland. A complete description of laboratory protocols can be found in Boward and Friedman (2000) and results of the QC analysis can be found in Mercurio et al. (2001).

Table 2-7. Analytical methods used for water chemistry samples collected during the spring index period.				
Analyte (units)	Method	Instrument	Detection Limit	Holding Time (days)
pH (standard units)	EPA (1987) Method 19	Orion pH meter	0.01	7
Acid neutralizing capacity ($\mu\text{eq/l}$)	EPA (1987) Method 5	Brinkmann Automated Titration System equipped with customized software	0.01	14
Sulfate (mg/l)*	EPA (1987) Method 11	Dionex DX-500 Ion Chromatograph (AS-9 HC column)	0.03	14
Nitrite nitrogen* (mg/l)	EPA (1999) Method 354.1	Lachat QuikChem Automated Flow Injection Analysis System	0.0005	28 (frozen)
Nitrate nitrogen* (mg/l)	EPA (1987) Method 11	Dionex DX-500 Ion Chromatograph (AS-9 HC column)	0.01	14
Ammonia (mg/l)*	EPA (1999) Method 350.1	Lachat QuikChem Automated Flow Injection Analysis System	0.003	28 (frozen)
Total dissolved nitrogen (mg/l)*	APHA (1998) 4500-N (B)	Lachat QuikChem Automated Flow Injection Analysis System w/In-line Digestion Module	0.050	28 (frozen)
Total particulate nitrogen (mg/l)	D'Elia et al. 1997	CE Elantech N/C Analyzer	0.0103	28
Orthophosphate (mg/l)*	APHA (1998) 4500-P (G)	Lachat QuikChem Automated Flow Injection Analysis System	0.0010	28 (frozen)
Total dissolved phosphorus (mg/l)*	APHA (1998) 4500-P (I)	Lachat QuikChem Automated Flow Injection Analysis System w/In-line Digestion Module	0.0013	28 (frozen)
Total particulate phosphorus (mg/l)	Aspila et al. 1976	Lachat QuikChem Automated Flow Injection Analysis System	0.0011	28
Chloride (mg/l)*	EPA (1987) Method 11	Dionex DX-500 Ion Chromatograph (AS-9 HC column)	0.02	14
Specific conductance ($\mu\text{mho/cm}$)	EPA (1987) Method 23	YSI Conductance Meter w/Cell	0.1	7
Dissolved organic carbon (mg/l)*	EPA (1987) Method 14	Dohrmann Phoenix 8000 Organic Carbon Analyzer	0.14	28
Particulate carbon (mg/l)	D'Elia et al. 1997	CE Elantech N/C Analyzer	0.0595	
* Indicates analyses that require filtration within 48 hours				

In macroinvertebrate monitoring, the decision to employ a particular subsample size (100 vs. 200 or greater) reflects a balance of how to best utilize program effort. While a larger subsample may improve precision in characterizing individual sites, each sample then requires additional effort for laboratory identification. If a program goal is better precision in characterizing watersheds, the added effort might be spent on a sampling more sites per watershed. At

the outset of the MBSS monitoring program, a decision was made that 100-organism subsamples would provide acceptable precision at the single site level, and that, within a given total cost, effort would instead be focused on maximizing the total number of sites that could be sampled. However, DNR is interested in further investigating the effect of 100- vs. 200-organism subsampling. In a related study currently underway with Montgomery County

Department of Environmental Protection (with EPA sponsorship), the effects of 100 vs. 200 organism subsampling will be evaluated, including optimization analysis to assess the tradeoffs between subsample size and total number of sites, given a fixed total cost for the monitoring program.

2.6.4 Fish

Fish were sampled during the summer index period using double-pass electrofishing within 75-meter stream segments. Block nets were placed at each end of the segment and direct current backpack electrofishing units were used to sample the entire segment. An attempt was made to thoroughly fish each segment on each pass, sampling all habitat within the entire stream segment. A consistent effort was applied over the two passes. This sampling approach allowed calculation of several metrics constituting the biological index and produced estimates of fish species abundance.

In small streams, a single electrofishing unit was used. In larger streams, two to five units were employed to effectively sample the site. Captured fish from each pass were identified to species, weighed in aggregate, counted, and released. Any individuals that could not be identified to species were retained for laboratory confirmation, and a voucher series of about 10 individuals was retained for each major (Maryland 6-digit) drainage basin. For each pass, all individuals of each gamefish species (defined as trout, bass, walleye, pike, chain pickerel, and striped bass) were measured for total length. For each species, unusual occurrences of visible external pathologies or anomalies were noted.

All voucher specimens and fish retained for positive identification in the laboratory were examined and verified by Dr. Rich Raesley, an ichthyologist at Frostburg State University, Frostburg, Maryland. All MBSS collections are archived in the fish museum at Frostburg State University.

2.6.5 Amphibians and Reptiles

At each segment sampled during the summer, amphibians and reptiles found during the course of electrofishing and other activities were captured, identified, and recorded. Individuals were identified to species when possible, but larval salamanders and tadpoles were not retained. Voucher specimens and individuals not positively identifiable in the field were retained for examination in the laboratory.

2.6.6 Mussels

During the summer index period, freshwater mussels were sampled by visual inspection at each 75-meter stream segment. The presence of Unionid mussels or Asiatic clam (*Corbicula fluminea*) was recorded as live, old shell, or recent shell.

2.6.7 Aquatic and Streamside Vegetation

During the summer index period, aquatic vegetation was sampled qualitatively by examining each 75-meter stream segment for the presence of aquatic plants. The presence and relative abundance of submerged, emergent, and floating aquatic vegetation were recorded.

In addition, the presence and relative abundance of invasive plant species (e.g., multiflora rose) were recorded during summer sampling.

2.6.8 Physical Habitat

Habitat assessments were conducted during summer sampling at all stream segments as a means of assessing the importance of physical habitat to the biological integrity and fishability of freshwater streams in Maryland. Procedures for habitat assessment (Kazyak 2000) were derived from two commonly used methodologies: EPA's Rapid Bioassessment Protocols (RBPs) (Plafkin et al. 1989), as modified by Barbour and Stribling (1991), and the Ohio EPA's Qualitative Habitat Evaluation Index (QHEI) (Ohio EPA 1987, Rankin 1989).

During spring, riparian zone vegetation type and width on each bank was estimated to the nearest meter (up to 50 meters from stream). Severity and type of buffer breaks were noted. Local land use type and the extent and type of stream channelization were recorded. Altitude and stream gradient were measured. Crews also recorded distance from road and assigned a trash rating (based on visible signs of human refuse at a site) to characterize human presence.

During summer sampling, several habitat characteristics (instream habitat, epifaunal substrate, velocity/depth diversity, pool/glide/eddy quality, and riffle/run quality) were assessed qualitatively on a 0-20 scale, based on visual observations within each segment. The percentage of embeddness of the stream channel and the percentage of shading of the stream site were estimated. Also recorded were the extent and severity of bank erosion and bar

formation, number of woody debris and rootwads within the stream channel, and the presence of various stream features such as substrate types, various morphological characteristics, and beaver ponds. Maximum depth within the segment was measured. Wetted width, thalweg depth, and thalweg velocity were recorded at four transects. A complete velocity/depth profile was taken at one transect to compute discharge (streamflow); for sites with extremely low flow, the speed of a floating object was substituted to allow calculation of discharge.

Recognizing that water temperature is an important factor affecting stream condition (but one that varies daily and seasonally), the Survey deployed temperature loggers at most sites. Onset Computer Corporation Optic Stowaway model temperature loggers were anchored in each sample site during the summer index period. They recorded the water temperature every 20 minutes from approximately June 1 until August 15.

2.7 QUALITY ASSURANCE

Quality assurance and quality control (QA/QC) are integral parts of the data collection and management activities of the Survey. The Survey employs well-established QA/QC procedures, as detailed in Kazyak (2000). Some key points are highlighted below.

2.7.1 Data Management

All crews used standardized pre-printed data forms developed for the Survey to ensure that all data for each sampling segment were recorded and standard units of measure were used. Using standard data forms facilitates data entry and minimizes transcription error. The field crew leader and a second reviewer checked all data sheets for completeness and legibility before leaving each sampling location. Original data sheets were sent to the Data Management Officer for further review, another signoff, and data entry, while copies were retained by the field crews.

A custom database application (written in Microsoft Access), in which the input module was designed to match each of the field data sheets, was used for data entry. Data were independently entered into two databases and compared using a computer program as a quality-control procedure. Differences between the two databases were resolved from original data sheets or through discussions with field crew leaders.

2.7.2 QA/QC for Field Sampling

A Quality Control Officer (QC Officer) experienced in all aspects of the Survey was appointed to administer the quality assurance program. Specific quality assurance activities administered by the QC Officer included preparing a field manual of standard sampling protocols, designing standard forms for recording field data, conducting field crew training and proficiency examinations, conducting field and laboratory audits, making independent habitat assessments, identifying taxa, reviewing all reports, and reporting errors.

To ensure consistent implementation of sampling procedures and a high level of technical competency, experienced field biologists were assigned to each crew and all field personnel completed program training before participating in field sampling. Training topics included MBSS program orientation, stream segment location using global positioning system (GPS) equipment, sampling protocols, operation and maintenance of sampling equipment, data transcription, quality assurance/quality control, and safety. The spring field crews received additional training in sampling protocols for water quality and benthic macroinvertebrates. The summer field crews received additional training in habitat assessment methods, taxonomy, and *in situ* water chemistry assessment.

Training included classroom, laboratory, and field activities. Instructors emphasized the objectives of the Survey and the importance of strict adherence to the sampling protocols. The QC Officer conducted proficiency examinations to evaluate the effectiveness of the training program and ensure that the participants had detailed knowledge of the sampling protocols. Members of the spring sampling crew were required to demonstrate proficiency in techniques for collecting samples for water chemistry and benthic macroinvertebrates. At least one member of each summer sampling crew was required to pass a comprehensive fish taxonomy examination. Each crew also demonstrated proficiency in locating pre-selected stream segments using the GPS receiver and determining if the segment was acceptable for sampling. Comprehensive "dry runs" were conducted to simulate actual field conditions and evaluate classroom instruction.

Field audits were conducted by the QC Officer during the field sampling to assess the adequacy of training, adherence to sampling protocols, and accuracy of data transcription. The audits included evaluation of the preparation and planning prior to field sampling, stream segment location using GPS equipment and assessment of acceptability for

sampling, adherence to sampling protocols, data transcription, and equipment maintenance and calibration. The QC Officer made an independent assessment of habitat at all segments where field audits were done (approximately 10% of the total number of sites).

A separate QA report (Mercurio et al. 2001) will report on details of QA activities for the 2000 sampling year.

2.8 CLIMATIC CONDITIONS

Because all flow in Maryland streams ultimately arises from precipitation, weather is an important factor in stream condition. In Maryland, annual precipitation varies geographically, averaging between 40 and 50 inches. In the western half of the state, the prevailing winds are from the west, typically mixing moisture from the south with colder temperatures from the north. Because of these prevailing winds and Maryland's mountain ridges (which create a rainshadow effect), rain and snowfall are greater in the west and precipitation tends to be heavier on west-facing slopes. In the eastern half of the state, prevailing winds are also westerly, but many storm events are also influenced by moisture from the coast and precipitation patterns there reflect that influence. These precipitation patterns have an obvious effect on runoff, a primary factor in determining stream characteristics. Because the flow of water (stream discharge) is one of the critical determinants of stream habitat quantity and quality, drier portions of the state should have less aquatic habitat than those that are wetter.

Temporal changes in the amount of precipitation are also important in determining the amount of habitat available to

aquatic organisms. Figures 2-3 through 2-5 show the monthly deviation from normal precipitation (in inches) for the years 1998-2000 (NOAA 1998, NOAA 1999, and NOAA 2000). This number is the average of the deviation from normal temperature in eight regions of the state, so it is possible that some effects seen only in the eastern portion of the state may be masked by events in the western portion of the state and vice versa. Actual monthly values for each region are shown in Appendix A.

In 1998, the first six months of the year were wetter than normal, with January, the wettest month, averaging 2.88 inches of precipitation wetter than normal. The last six months of 1998 were drier than normal, with November averaging 2.45 inches of precipitation less than normal. Total precipitation for 1998 was 1.66 inches above normal. The spring and summer of 1999 experienced drought conditions (especially noticed in the eastern portions of the state) with the average precipitation in April through July experiencing between 2.44 and 1.64 inches less precipitation than normal. In September, Hurricane Floyd hit most of central and eastern Maryland, causing average precipitation to jump to almost 7 inches above normal. During this month, some streams, including Gwynns Falls in Baltimore, exceeded the flood of record. By October, precipitation had stabilized to normal, and in November and December, the state was experiencing less than normal amounts of precipitation. Total precipitation for 1999 was 0.58 inches below normal, showing that the extended drought had more of influence on precipitation patterns than the hurricane. Spring and summer months of 2000 experienced greater than normal amounts of precipitation (with the exception of May), while fall and winter months experienced less precipitation than normal.

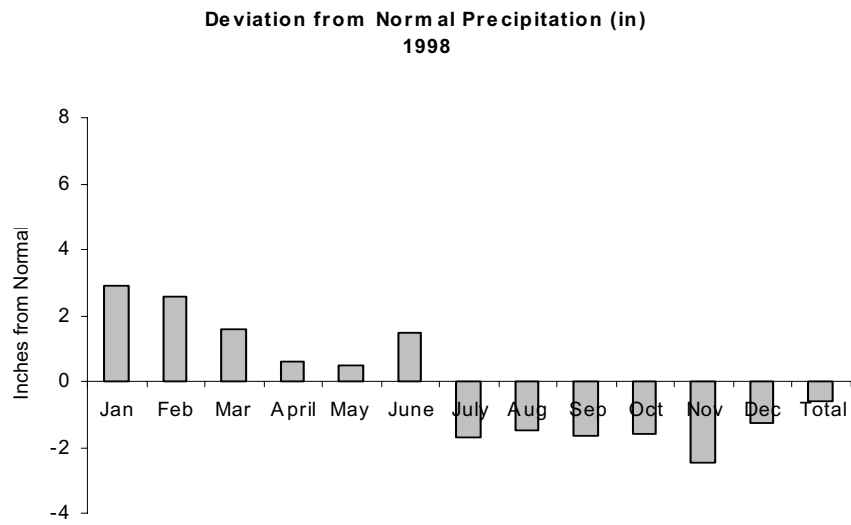


Figure 2-3. Statewide average deviation from normal precipitation during 1998

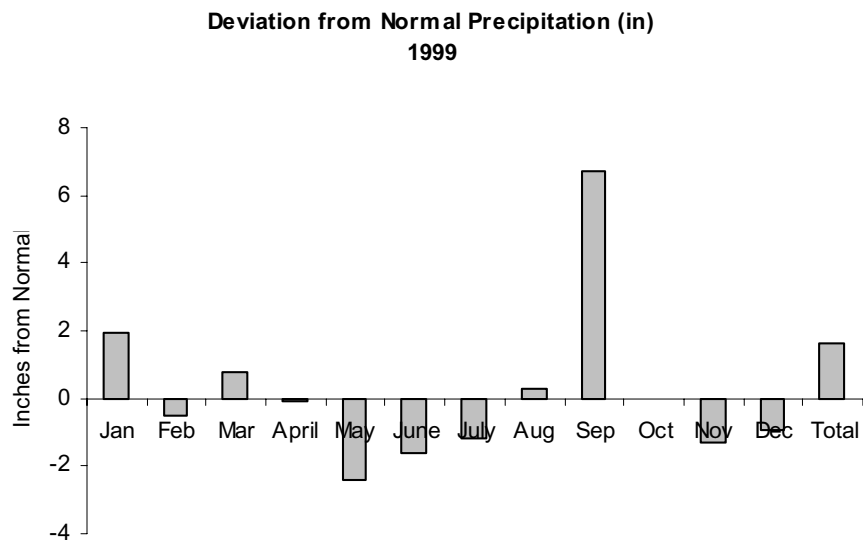


Figure 2-4. Statewide average deviation from normal precipitation during 1999

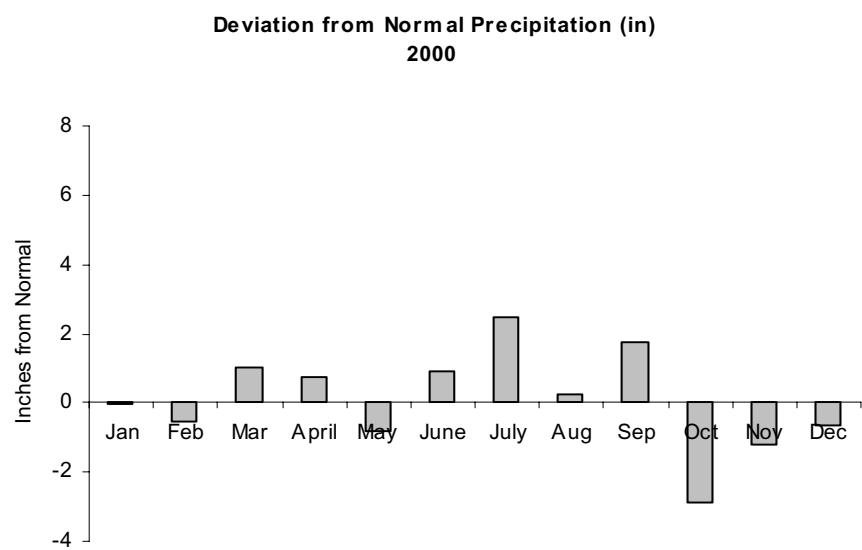


Figure 2-5. Statewide average deviation from normal precipitation during 2000

3 THE STATE OF THE STREAMS: COMPARATIVE ASSESSMENT OF WATERSHEDS SAMPLED IN 2000

This chapter provides a comparative assessment of the watersheds sampled by the MBSS (or Survey) in 2000. Separate sections focus on biodiversity, biological indicator results, and three predominant issues affecting biological resources: acidification, physical habitat, and nutrients and other water chemistry. The indicators used were developed during Round One of the MBSS and have been deemed reliable for representing ecological condition by field verification and expert peer review. Nonetheless, the MBSS continues to pursue refinements to its indicators including improvements to the provisional physical habitat index (PHI), methods for combining indicators that do not lose information (e.g., combined biotic index), and changes to the indicator thresholds and scoring methods to make them more intuitive and accessible to the public.

3.1 BIODIVERSITY

In addition to assessing the integrity of streams and watersheds, the Survey provides invaluable information on the abundance and distribution of rare species. Documenting the presence (and ultimately abundance in the five-year Round Two report) of rare species, the Survey supports a more thorough characterization of Maryland's biodiversity. During MBSS sampling in 2000, a number of rare or unusual occurrences of fish were documented. This chapter presents a brief summary of particularly noteworthy findings. The sole state-listed species observed at core MBSS sites in 2000 was the glassy darter (*Etheostoma vitreum*). In addition, the state-listed mud sunfish (*Acantharchus pomotis*), flier (*Centrarchus macropterus*), and ironcolor shiner (*Notropis chalybaeus*) were captured at sites sampled in MBSS special studies. Complete taxa lists of fish, benthic macroinvertebrates, amphibians, and reptiles observed in each PSU are included in Chapter 4 of this report.

Potomac sculpin (*Cottus girardi*), a species previously thought to be restricted to the Potomac River drainage, was collected in the Prettyboy Reservoir watershed within the Gunpowder basin. Based on the number and distribution of fish collected, this occurrence likely represents a reproducing population. In contrast, a lone glassy darter, listed by Maryland DNR as endangered, was collected in Morgan Run within the Liberty Reservoir PSU of the Patapsco basin. This record represents a significant deviation from the known range of the species and its status as a

reproducing unit is questionable. Glassy darter was also collected from the Little Patuxent River PSU, an area where it was collected during 1995-97 MBSS sampling.

Sampling results from the MBSS in 2000 extended the known range of the pearl dace (*Margariscus margarita*). This species is primarily confined to the Antietam Creek portion of the Upper Potomac basin, but new populations were documented in Toms Creek (Upper Monocacy PSU), Carroll Creek (Lower Monocacy PSU), and Rock Creek (Lower Monocacy PSU). Each of these locations is in the Middle Potomac basin. Pearl dace were also collected in the Marsh Run watershed (Upper Potomac basin) during 2000, but Marsh Run is a tributary to Antietam Creek. The known range of checkered sculpin (*Cottus* sp. n.) was also extended in 2000, as a population was documented in Carroll Creek (Lower Monocacy PSU, Middle Potomac basin). Like pearl dace, this species is primarily confined to the Antietam Creek watershed.

In addition to the above, banded sunfish (*Enneacanthus obesus*), a species rarely found in Maryland, was collected from the Aberdeen Proving Ground, Wicomico River Head, Monie Bay, and Nassawango (a Sentinel site) watersheds during 2000 sampling. The Nassawango record represents the first documented occurrence in the Nanticoke basin. Another new record for the MBSS was documented in the St. Mary's PSU. Flier, a species found only in Zekiah Swamp during the 1995-1997 MBSS, was collected in the St. Mary's PSU. Other uncommon species documented during 2000 sampling were American brook lamprey (*Lampetra appendix*, Little Patuxent River PSU), and swamp darter (*Etheostoma fusiforme*, Upper Choptank and Lower Wicomico PSUs, and Nassawango Creek watershed). In addition to the above species collected during sampling at randomly selected sites, ironcolor shiner were only collected at a single site (in the St. Mary's PSU) during 2000. Sampling at this site was done as part of an assessment for the U.S. Army Corps of Engineers. Also, mud sunfish were found at the Nassawango Creek Sentinel site.

Also of note during 2000 sampling was the presence of brook trout (*Salvelinus fontinalis*) in a stream heavily impacted by a beef cattle pasture. This site, in the Prettyboy Reservoir PSU (Gunpowder basin), had extensive silt deposits and habitat uncharacteristic of a brook trout stream. However, the area just above the segment was forested and likely serves as a refuge when conditions in the pasture are

unfavorable. In addition, there was an active spring within the segment. This occurrence reinforces the importance of noting extraordinary or mitigating circumstances observed during sampling.

3.2 BIOLOGICAL INDICATORS

The Index of Biotic Integrity (IBI) is a stream assessment tool that evaluates biological integrity based on characteristics of the fish or benthic assemblage at a site. Biological integrity is defined as

the ability to support and maintain a balanced, integrated, adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of the natural habitat of the region.

-- Karr and Dudley (1981) as cited in Karr (1991)

To develop an IBI, reference sites are selected to represent regional natural habitats, also referred to as “minimally impacted” conditions. We recognize that virtually no streams in Maryland are entirely undisturbed by human activities. Atmospheric deposition of contaminants alone reaches all parts of the State; few streams have natural temperature regimes; and more than 1,000 man-made barriers to fish migration have been documented in Maryland. Therefore, reference conditions currently in use should not be viewed as completely natural or pristine. They are, however, a representative sample of the best streams that currently exist in the State. Whether these

conditions are the best attainable depends on future restoration activities and the goals of DNR, other agencies, and the public.

Sites were evaluated using both the fish and benthic IBIs developed for the MBSS, indicators previously employed in evaluating Round One results (Roth et al. 1999). For details about IBI development, see Roth et al. (2000) and Stribling et al. (1998). IBI scores for each site were determined by comparing the fish or benthic assemblage to those found at minimally impacted reference sites. Three separate formulations were employed for the fish IBI, one for each of three distinct geographic areas: Coastal Plain, Eastern Piedmont, and Highlands. Two different formulations of the benthic IBI were used in the Coastal Plain and non-Coastal Plain regions. IBIs were calibrated specifically for each ecological region during their development.

The MBSS computes the IBI as the average of individual metric scores. Individual metric scores are based on comparison with the distribution of metric values at reference sites within each geographic stratum. Metrics are scored 1 (if < 10th percentile of reference value), 3 (10th to 50th percentile), or 5 (\geq 50th percentile). The final IBI scores are calculated as the average of three scores and therefore range from 1 to 5. An IBI \geq 3 indicates the presence of a biological community with attributes (metric values) comparable to those of reference sites, while an IBI < 3 means that, on average, metric values fall short of reference expectations. Table 3-1 contains narrative descriptions for each of the IBI categories developed for the Survey. Because an IBI score of 3 represents the threshold of reference condition, values less than 3 (i.e., poor or very

Table 3-1. Narrative descriptions of stream biological integrity associated with each of the IBI categories		
Good	IBI score 4.0 - 5.0	Comparable to reference streams considered to be minimally impacted. On average, biological metrics fall within the upper 50% of reference site conditions.
Fair	IBI score 3.0 - 3.9	Comparable to reference conditions, but some aspects of biological integrity may not resemble the qualities of these minimally impacted streams. On average, biological metrics fall within the lower portion of the range of reference sites (10th to 50th percentile).
Poor	IBI score 2.0 - 2.9	Significant deviation from reference conditions, with many aspects of biological integrity not resembling the qualities of these minimally impacted streams, indicating degradation. On average, biological metrics fall below the 10th percentile of reference site values.
Very Poor	IBI score 1.0 - 1.9	Strong deviation from reference conditions, with most aspects of biological integrity not resembling the qualities of these minimally impacted streams, indicating severe degradation. On average, biological metrics fall below the 10th percentile of reference site values; most or all metrics are below this level.

poor) represent sites suspected to be degraded. In contrast, values greater than or equal to 3 (i.e., fair or good) indicate that most attributes of the community are within the range of those at reference sites. Highest scores (IBI of 4 to 5) were designated as good, recognizing that available reference sites do not necessarily represent the highest attainable condition. The assignment of scores to narrative categories is a useful method for translating scores into a form that is easily communicated.

The sections below contain a summary of biological indicator results for MBSS core sites sampled in 2000. Included are the fish IBI, benthic IBI, and an integrated analysis of both bioindicators, the Combined Biotic Index (CBI). Additional analyses conducted specifically for applying Maryland's interim biocriteria framework are presented in Chapter 7.

3.2.1 Fish IBI Results

Although a target of sampling 10 sites per PSU was set, in some cases fewer than 10 sites received fish IBI scores

(Table 3-2). A total of 199 core sites in 18 PSUs were sampled for fish during summer 2000. Of these sites, 31 sites were not rated by the fish IBI, as they were very small headwater streams (each with a catchment area less than 300 acres) where expectations of fish abundance and diversity are too low for development of an effective indicator.

In addition, because the fish IBI may underrate coldwater and blackwater streams owing to their naturally low species diversity, evidence of these stream types was used as a secondary indicator in interpreting scores. Sites where brook trout were present (a clear sign of coldwater conditions) and where fish IBI scores were less than 3 were excluded from analysis and reported as "not rated." This situation was rare (1 site). Along with low species richness, naturally acidic blackwater streams may also be dominated by a few acid-tolerant species. Because of the concern for possibly underrating blackwater streams, the 8 blackwater streams with fish IBI scores less than 3 were excluded from analysis and were instead classified as "not rated." Blackwater streams were defined as sites with either pH < 5 or ANC < 200 $\mu\text{eq/l}$ and DOC > 8 mg/l. Over time, the

PSU NAME	Number of Sites Fished	Number of Sites < 300 acres	Number of Brook Trout Sites with FIBI < 3	Number of Blackwater Sites with FIBI < 3	Number of Sites Available for FIBI
Aberdeen Proving Ground/Swan Creek	9	2	0	0	7
Brighton Dam	11	2	0	0	9
Casselman River	10	0	0	0	10
Corsica River/Southeast Creek	10	1	0	1	8
Fifteen Mile Creek	8	1	0	0	7
Liberty Reservoir	16	2	0	0	14
Little Patuxent River	13	1	0	0	12
Lower Wicomico/Monie Bay/Wicomico Creek/Wicomico River Head	10	1	0	5	4
Mattawoman Creek	10	2	0	0	8
Nanjemoy Creek	10	3	0	1	6
Patapsco River Lower North Branch	13	3	0	0	10
Potomac R WA County/Marsh Run/Tonoloway/Little Tonoloway	12	1	0	0	11
Prettyboy Reservoir	10	1	0	0	9
S Branch Patapsco	10	3	0	0	7
St. Mary's River	9	2	0	0	7
Town Creek	8	1	0	0	7
Upper Choptank	13	2	0	1	10
Upper Monocacy River	17	3	1	0	13
TOTAL	199	31	1	8	159

Survey plans to build its database of coldwater and blackwater streams to the point where it can develop biological indicators particular to these special stream types.

Other factors that may affect fish IBI scores should be considered in interpreting scores for individual sites. Sites with natural features such as bedrock substrate or a small, shallow stream channel may naturally support few species. Dams and other barriers to fish migration can block access to formerly inhabited upstream areas. In contrast, proximity of a site to a lake, pond, swamp, or impoundment can make a site more accessible to lentic species not typically found in the streams sampled by the Survey. Nearness to a large river confluence can similarly alter the pool of available species. Finally, high species richness owing to the presence of both Coastal Plain and Piedmont species at sites along the Fall Line may result in artificially high IBI scores in this transitional area.

Fish IBI scores for sites sampled in the 2000 MBSS spanned the full range of biological condition, from 1.0 (very poor) to 5.0 (good). Fish IBI data for each PSU are depicted in Figure 3-1 and listed in Appendix Table B-1. Mean fish IBIs for PSUs sampled in 2000 are mapped in Figure 3-2. Over the next four years of Round Two sampling, data will be collected in remaining PSUs to complete an updated statewide picture of biological conditions. Mean fish IBI per PSU ranged from 2.12 (Potomac River Washington County/Marsh Run/Tonoloway/Little Tonoloway PSU; hereafter referred to as Potomac River Washington County PSU) to 3.98 (Liberty Reservoir). Note that fish IBI scores are less variable within some PSUs (e.g., Liberty Reservoir, Brighton Dam, South Branch Patapsco) than others (e.g., Town Creek, Fifteen Mile Creek).

Data were also used to estimate the extent of streams in poor to very poor condition within each PSU. The MBSS Round Two study design, based on simple random sampling, makes it possible to calculate an exact confidence interval around each estimate based on the binomial distribution. The extent of streams within a given condition (e.g., $IBI < 3$) is expressed as a percentage of all first-through fourth-order stream miles in the PSU, with an associated 90% confidence interval around the estimate. The 90% confidence interval was selected as the most appropriate for balancing the variability of the data and the need for information to support management decisions. This recognizes that requiring very high confidence will lead to an unnecessary large number of decisions not to act.

Figure 3-3 shows the 90% confidence intervals for the percentage of stream miles with fish $IBI < 3$, by PSU. Values are listed in Appendix Table B-2. Results indicate that Liberty Reservoir has the least extensive occurrence of poor to very poor fish IBI scores. With 90% confidence, we can say that only 0-19% of stream miles in Liberty Reservoir PSU had poor to very poor fish IBI. In contrast, with 90% confidence we can say that 30 to 85% of stream miles in Casselman River PSU had poor to very poor fish IBI.

Note that confidence intervals are most narrow where (1) conditions tend to be homogeneous (i.e., one condition occurs at all or nearly all sites, whereas the alternative condition occurs at 0 or few sites) and (2) the number of samples is high. For PSUs with small sample size, the confidence interval is, as expected, fairly wide. For example, the four sites in Lower Wicomico/Monie Bay/Wicomico Creek/Wicomico River Head PSU (hereafter referred to as Lower Wicomico PSU) predict with 90% confidence that 10 to 90% of stream miles are in poor to very poor condition. Completion of all Round Two sampling by 2004 will allow estimation of statewide and basin-specific conditions. At the basin level, larger sample sizes will result in much narrower confidence intervals, with precision comparable to Round One basin results.

3.2.2 Benthic IBI Results

Benthic IBI scores were calculated for the 211 core sites sampled in spring 2000. Scores spanned the full range of biological conditions, from 1.0 (very poor) to 4.78 (good). Benthic IBI data for each PSU are shown in Figure 3-4 and listed in Appendix B-3. Mean benthic IBIs by PSU are mapped in Figure 3-5. The lowest mean benthic IBI was 1.60 in Lower Wicomico PSU; however, the presence of several blackwater stream sites may have contributed to low scores. The highest mean benthic IBI was 3.96 in Prettyboy Reservoir PSU. Variability within PSUs ranged from low (Fifteen Mile Creek, Potomac River Washington County, Liberty Reservoir, and Prettyboy Reservoir PSUs) to high (Casselman River).

The extent of occurrence of streams with benthic $IBI < 3$ were calculated, along with 90% confidence intervals. Values are listed in Appendix Table B-4. As shown in Figure 3-6, an estimated 53 to 97% of stream miles in Aberdeen Proving Ground/Swan Creek PSU had benthic

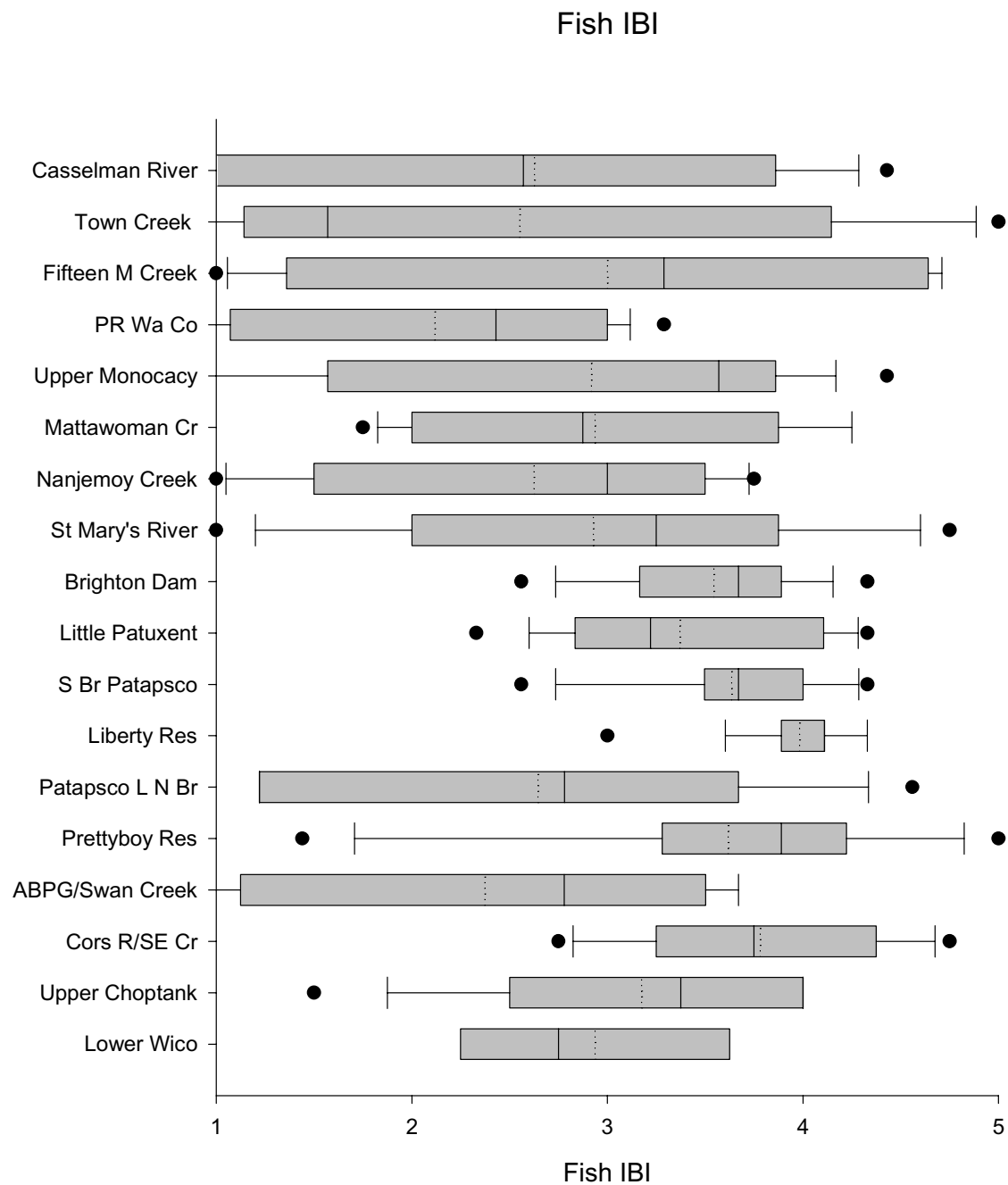


Figure 3-1. Distribution of fish Index of Biotic Integrity (IBI) scores for the MBSS PSUs sampled in 2000. The solid line indicates the median value of the data, while the dotted line indicates the mean value. The grey box delineates the 25th and 75th percentiles of the data, while the whiskers indicate the 10th and 90th percentiles of the data. Dots indicate outliers.

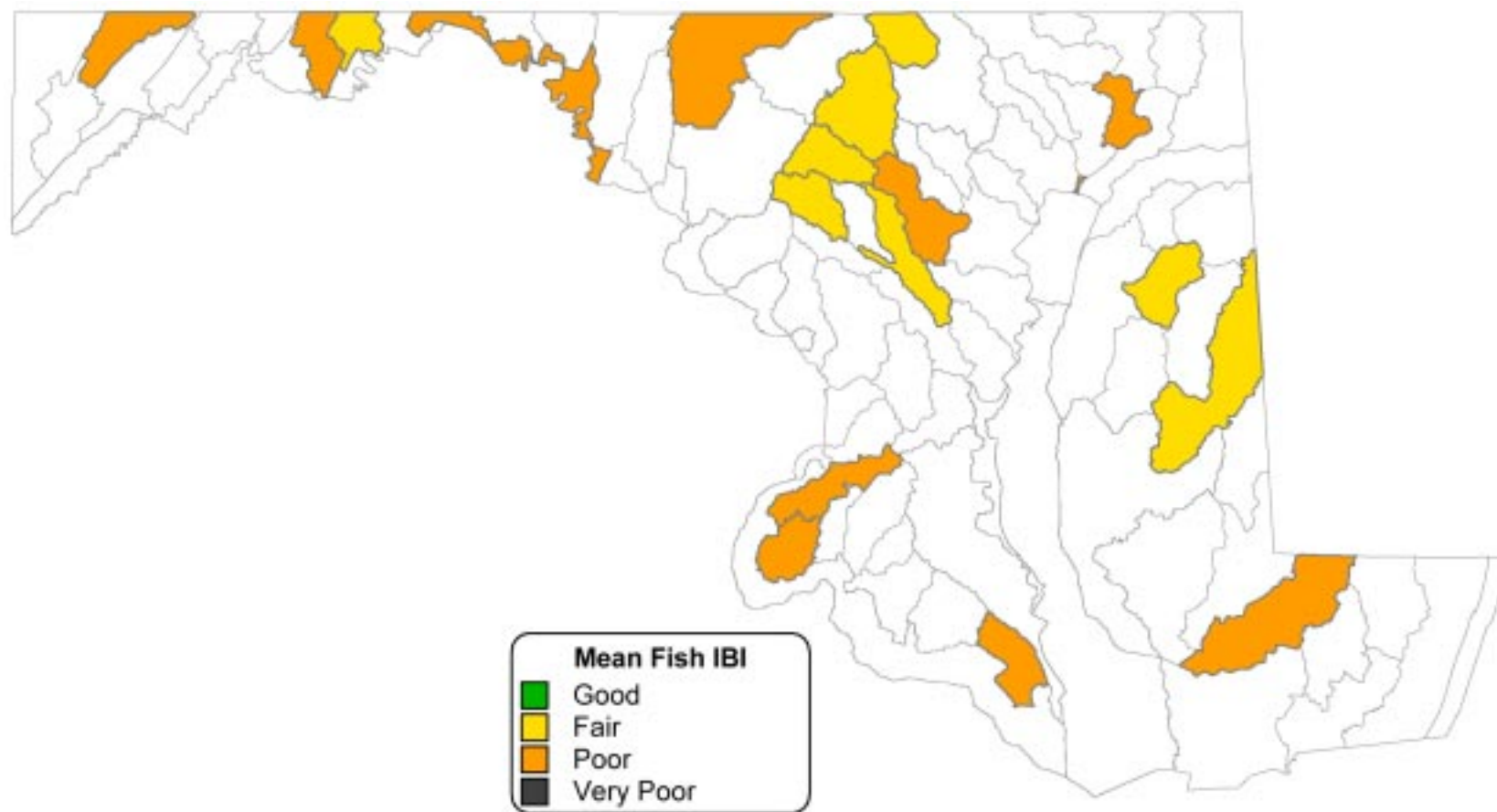


Figure 3-2. Mean fish Index of Biotic Integrity (IBI) in MBSS PSUs sampled in 2000

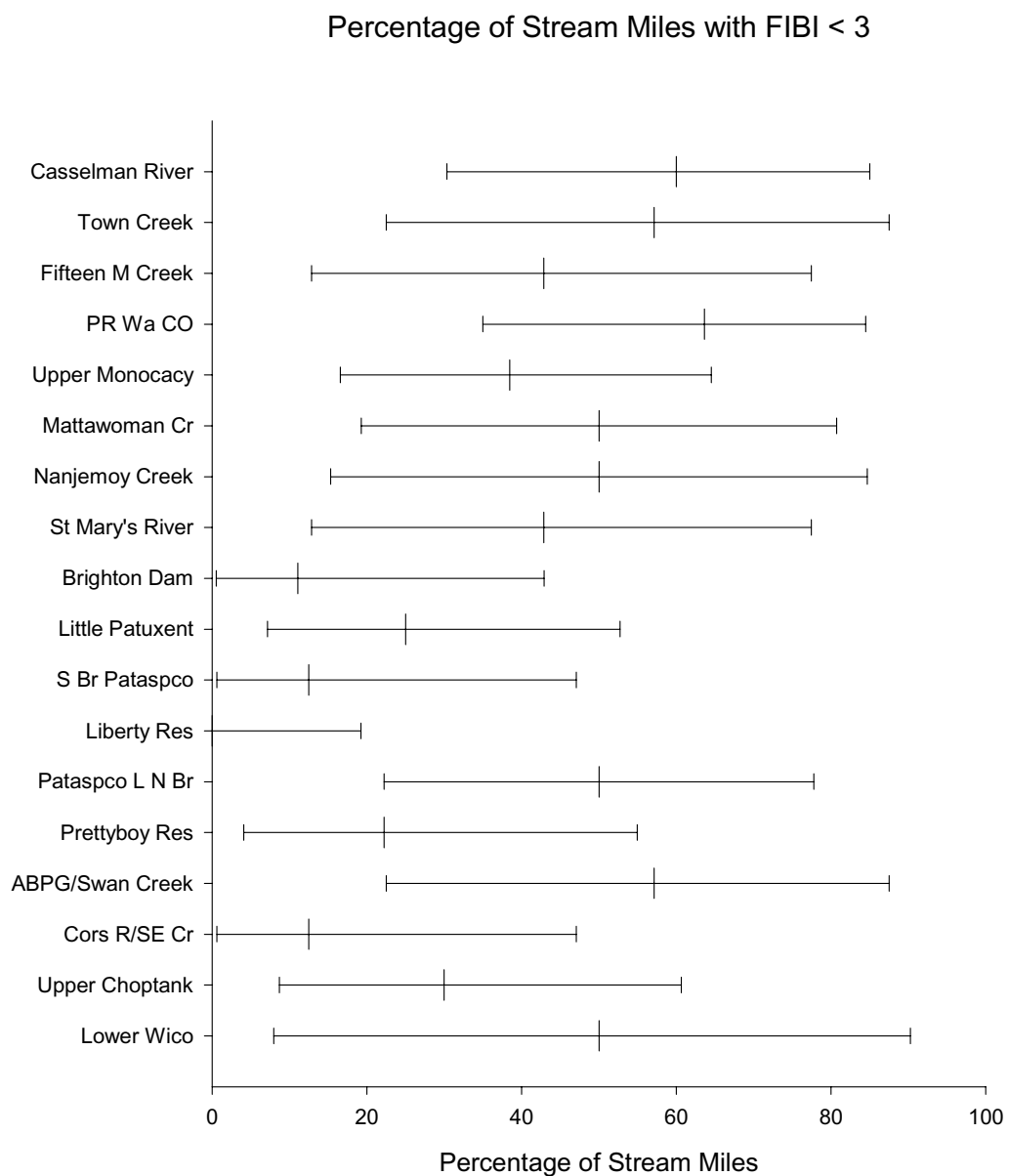


Figure 3-3. Percentage of stream miles with fish Index of Biotic Integrity (IBI) scores < 3.0 for the MBSS PSUs sampled in 2000

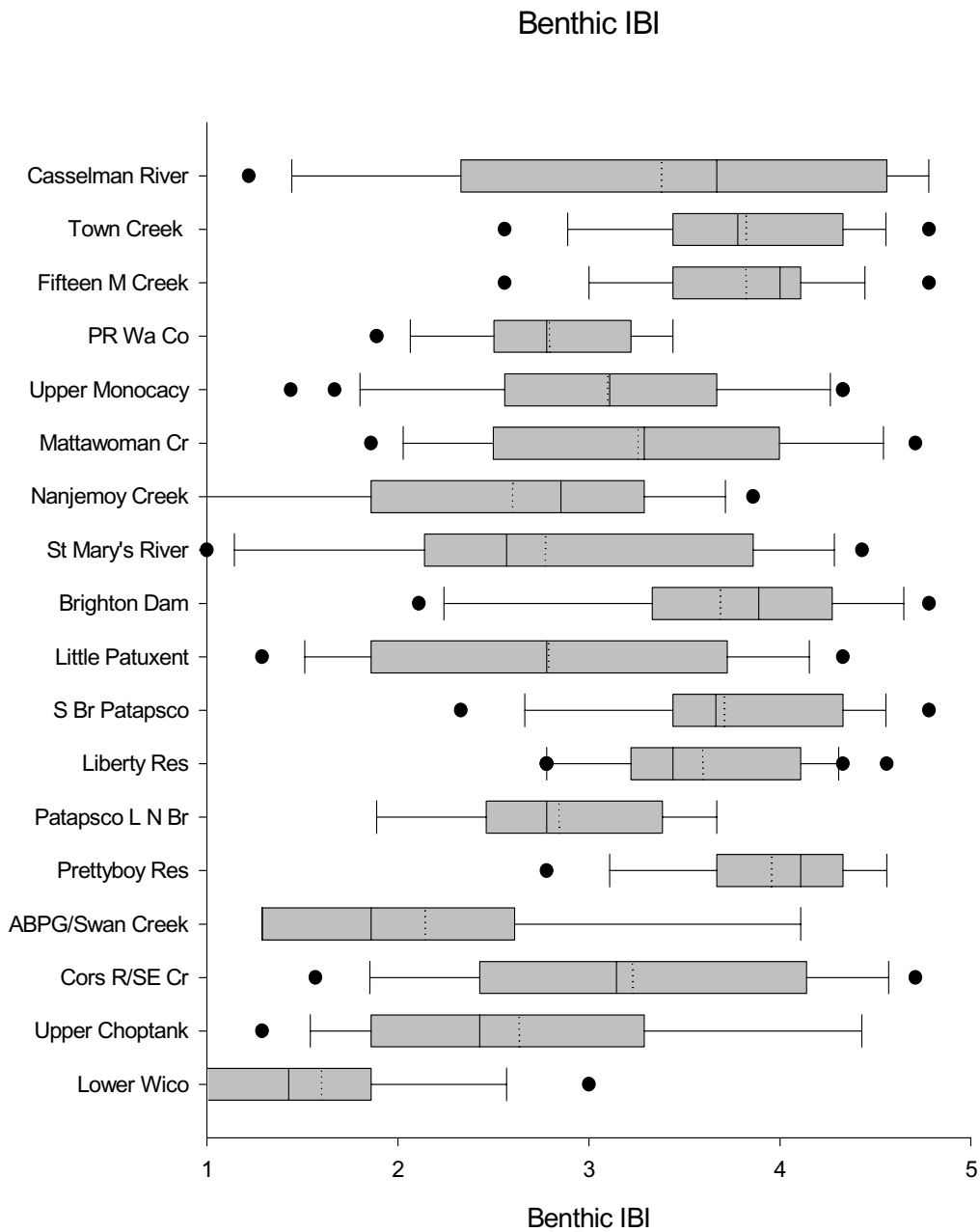


Figure 3-4. Distribution of benthic Index of Biotic Integrity (IBI) scores for the MBSS PSUs sampled in 2000

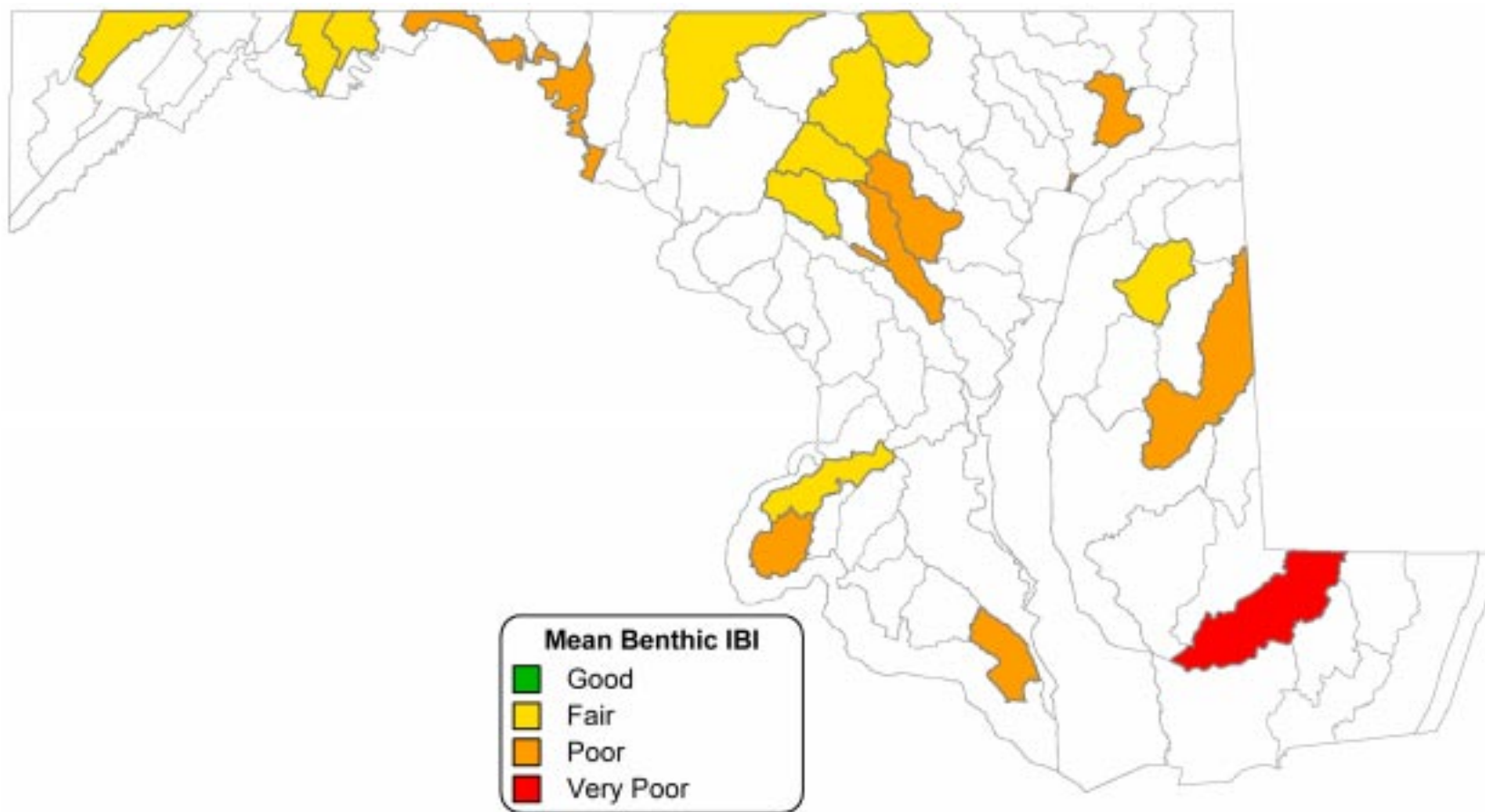


Figure 3-5. Mean benthic Index of Biotic Integrity (IBI) in MBSS PSUs sampled in 2000

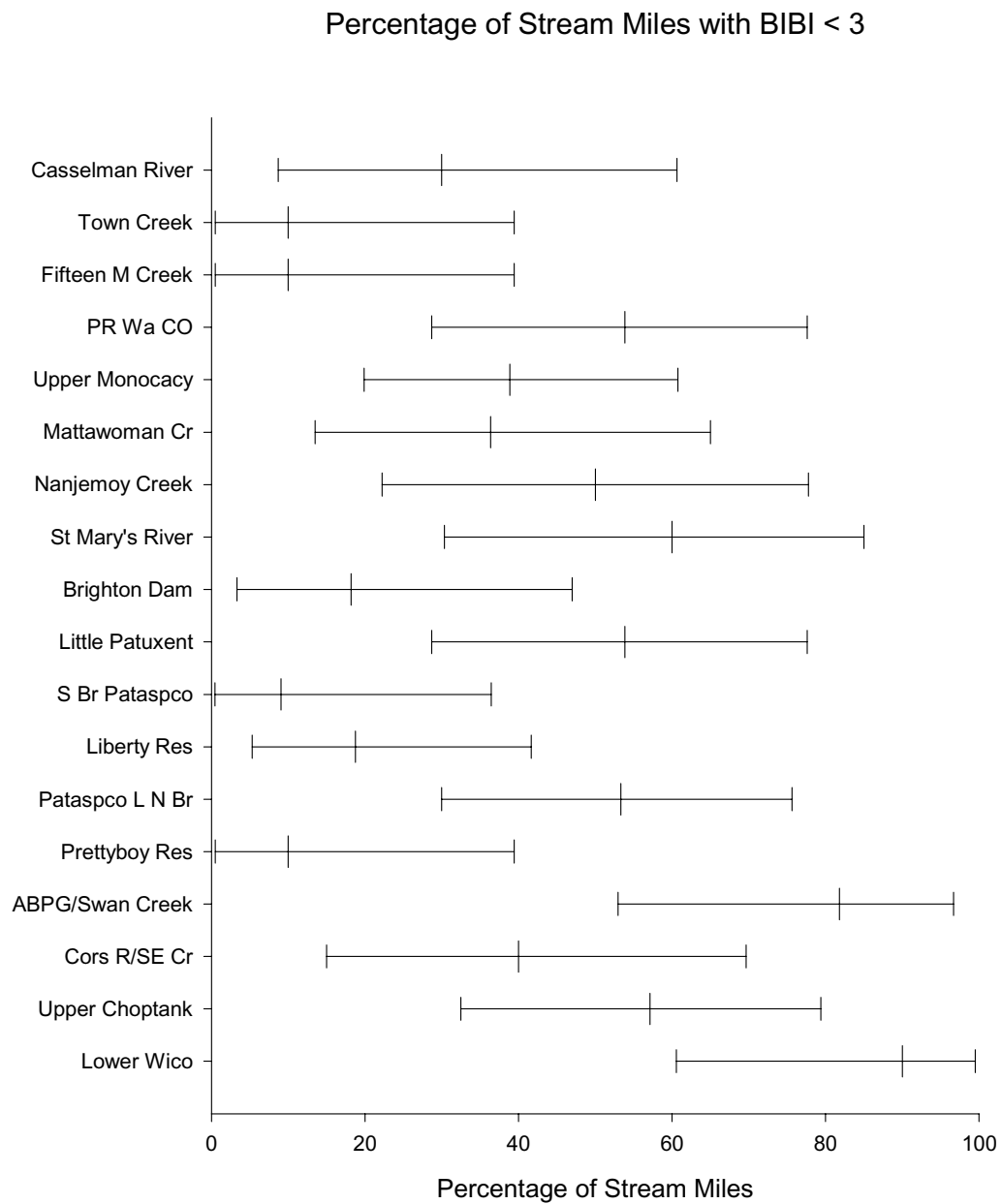


Figure 3-6. Percentage of stream miles with benthic Index of Biotic Integrity (IBI) scores < 3.0 for the MBSS PSUs sampled in 2000

IBI < 3, as did an estimated 61 to 99% of stream miles in Lower Wicomico PSU. In contrast, estimates for several other PSUs indicated less extensive occurrence of low benthic IBI. For example, an estimated 3 to 47% of stream miles in Brighton Dam PSU, 0.5 to 47% of stream miles in South Branch Patapsco PSU, and 0.5 to 39% of stream miles in Prettyboy Reservoir PSU had benthic IBI < 3.

3.2.3 Combined Biotic Index Results

To integrate the results of fish and benthic IBI assessments, a Combined Biotic Index (CBI) was assigned to each site. If both IBI scores were available for a site, the CBI was calculated as the mean of the fish and benthic IBI values. If

only one score was available (e.g., benthic IBI but no fish IBI), the single score was assigned as the CBI. Interpretation of CBI scores follows the guidelines in Table 3-2.

CBI scores from core MBSS sites ranged from 1.0 (very poor) to 4.67 (good). CBI data for each PSU are depicted in Figure 3-7 and listed in Appendix Table B-5. Mean CBI values by PSU are mapped in Figure 3-8. Mean CBI per PSU ranged from 1.79 (Lower Wicomico PSU) to 3.82 (Prettyboy Reservoir), paralleling benthic IBI results. The 90% confidence intervals for percentage of stream miles with CBI < 3 are shown in Figure 3-9 and Appendix Table B-6.

A snapshot of good and bad conditions is illustrated by sites with the 10 best and 10 worst Combined Biotic Index (CBI) scores. Sites with the best scores were distributed across the state. As expected, many drained forested catchments less disturbed by human impacts. None had a high degree of urbanization. The relative influence of agriculture varied, but the best sites highlighted here tended to have good riparian buffer and good physical habitat, even when located in a highly agricultural catchment.

10 best sites in watersheds sampled by MBSS 2000, as rated by the Combined Biotic Index (CBI)

Stream Name	Site	Order	Basin	Watershed Name	CBI
TOWN CR	TOWN-409-R-2000	4	UP	Town Creek	4.60
WAREHOUSE RUN	STMA-104-R-2000	1	LP	St. Mary's River	4.59
MATTAWOMAN CREEK UT3	MATT-212-R-2000	2	LP	Mattawoman Creek	4.48
PEGGY'S RUN	PRET-214-R-2000	2	GU	Prettyboy Reservoir	4.44
FIFTEENMILE CR	FIMI-401-R-2000	4	UP	Fifteen Mile Creek	4.41
THREE BRIDGES BR UT1	CORS-108-R-2000	1	CR	Corsica River	4.36
PINEY BRANCH	MATT-216-R-2000	2	LP	Mattawoman Creek	4.34
PATUXENT R UT1	BRIG-132-R-2000	1	PX	Brighton Dam	4.33
SOUTH BR CASSELMAN R	CASS-104-R-2000	1	YG	Casselman River	4.32
FRIENDS CR	UMON-304-R-2000	3	MP	Upper Monocacy River	4.27

Sites with the worst scores represented a broad range of stream problems. Severe agricultural impacts were evident, from cattle access to streams (where no streamside vegetation buffer was present and livestock had immediate access to the stream) and from runoff at a chicken farm. Channelization was common in both rural and urban streams. Other sites were affected by urban development and extensive impervious surface. Sites on a golf course were subject to habitat and flow modifications. Signs of acidic deposition and acid mine drainage were apparent at the two low-scoring sites in Casselman River watershed.

10 worst sites in watersheds sampled by MBSS 2000, as rated by the Combined Biotic Index (CBI)

Stream Name	Site	Order	Basin	Watershed Name	CBI
BEAVERDAM CREEK	LOWI-113-R-2000	1	NW	Lower Wicomico River	1.00
LITTLE SHADE RUN	CASS-102-R-2000	1	YG	Casselman River	1.11
ROMNEY CREEK UT2	ABPG-103-R-2000	1	BU	Aberdeen Proving Ground	1.14
LITTLE LAUREL RUN	CASS-111-R-2000	1	YG	Casselman River	1.33
ROMNEY CREEK UT1	ABPG-113-R-2000	1	BU	Aberdeen Proving Ground	1.39
MUNSON SPRING BRANCH	LTON-114-R-2000	1	UP	Little Tonoloway Creek	1.44
PATAPSCO R UT1	PATL-127-R-2000	1	PP	Patapsco River L N Br	1.56
GLADE CREEK	UMON-106-R-2000	1	MP	Upper Monocacy River	1.56
ROMNEY CREEK UT1	ABPG-118-R-2000	1	BU	Aberdeen Proving Ground	1.57
ST MARY'S RIVER UT2	STMA-112-R-2000	1	LP	St. Mary's River	1.64

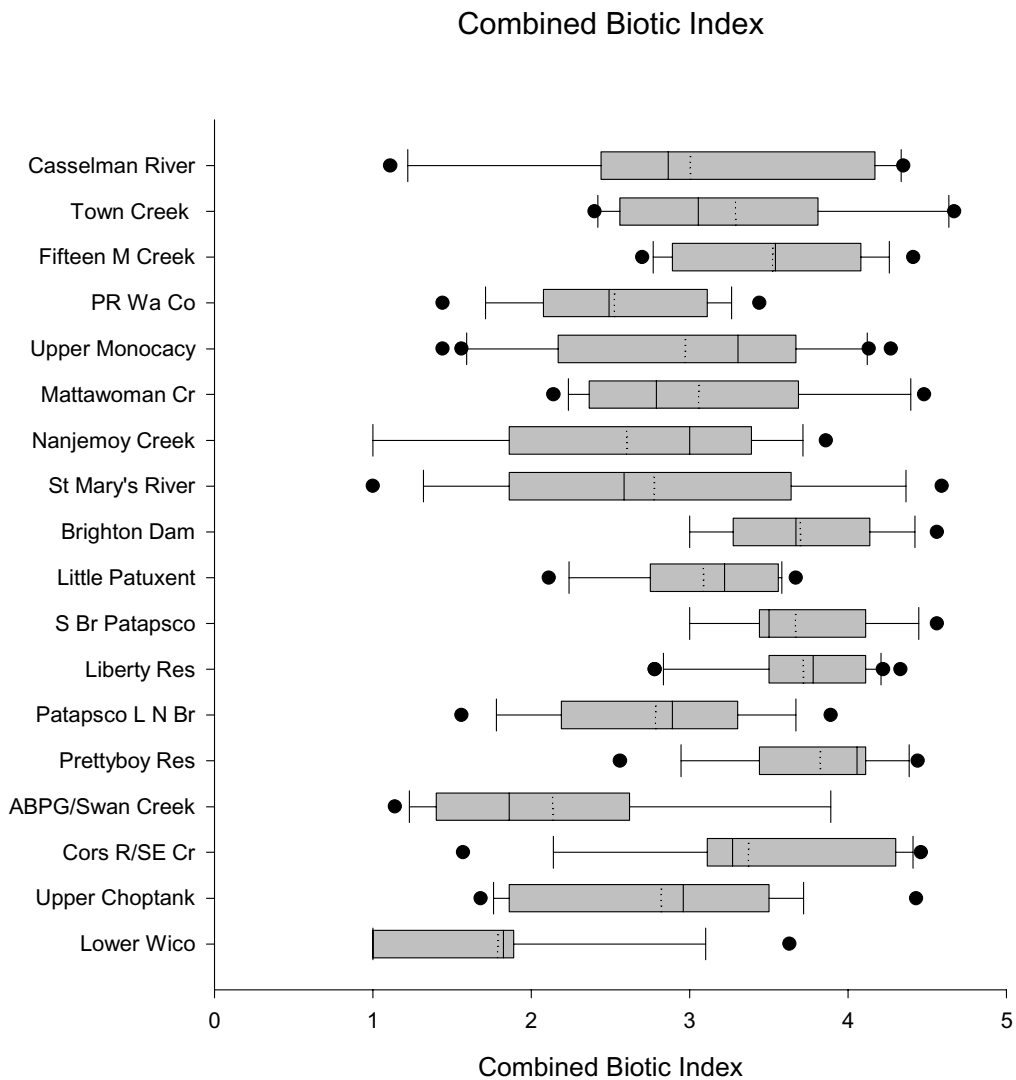


Figure 3-7. Distribution of the Combined Biotic Index (CBI) for the MBSS PSUs sampled in 2000

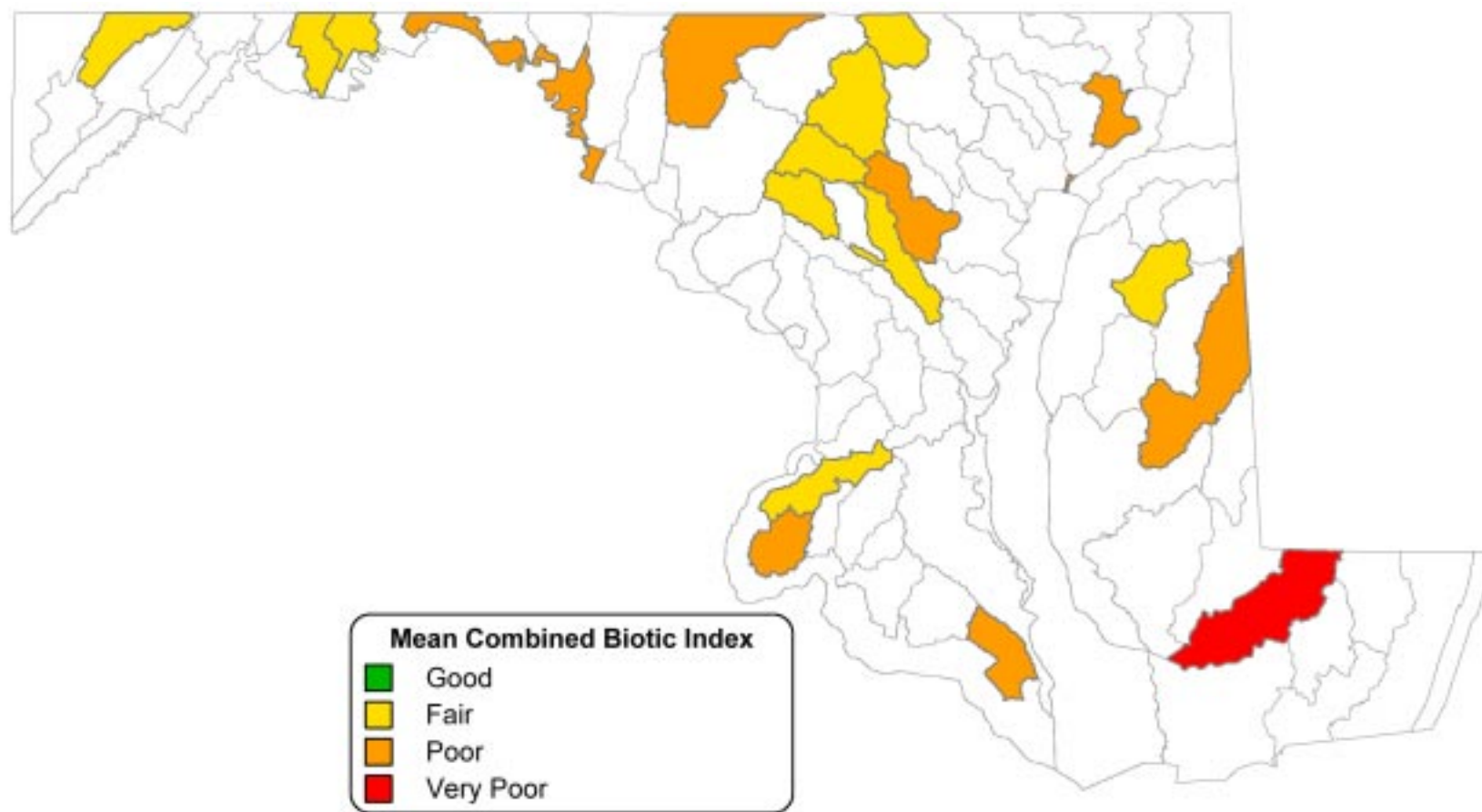


Figure 3-8. Mean Combined Biotic Index (CBI) in MBSS PSUs sampled in 2000

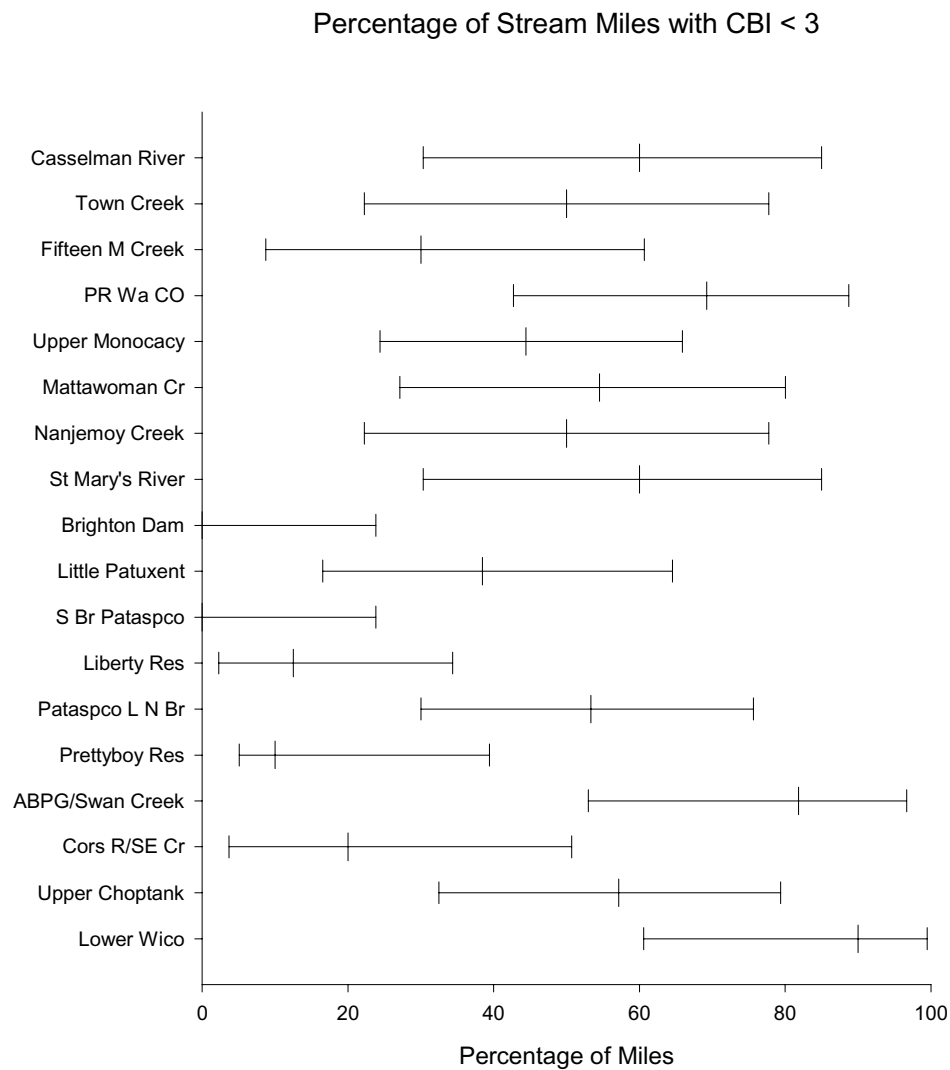


Figure 3-9. Percentage of stream miles with Combined Biotic Index (CBI) scores < 3.0 for the MBSS PSUs sampled in 2000

3.3 ACIDIFICATION

The effects of acidic deposition and acid mine drainage (AMD) on stream chemistry are well documented. Maryland's 1987 Synoptic Stream Chemistry Survey (MSSCS; Knapp et al. 1988) concluded that approximately one-third of all headwater streams in Maryland are sensitive to acidification or are already acidic. Acidification is known to cause declines in both the diversity and abundance of aquatic biota. Round One MBSS results (Roth et al. 1999) and an assessment of these results in comparison with critical loads (Miller et al. 1998) confirmed that stream acidification remains a problem in Maryland freshwater streams.

The defining characteristics of surface waters sensitive to acidification are low to moderate pH and acid neutralizing capacity (ANC). pH is a measure of the acid balance of a stream. The pH scale ranges from 0 to 14, with pH 7 as neutral and pH < 7 signifying acidic conditions. Biological effects are often noted at pH < 5 or 6. ANC is a measure of the capacity of dissolved constituents in the water to react with and neutralize acids and is used as an index of the sensitivity of surface water to acidification. The higher the ANC, the more acid a system can assimilate before experiencing a decrease in pH. Repeated additions of acidic materials can cause a decrease in ANC. In many acidic deposition studies (e.g., Schindler 1988), an ANC of 200 $\mu\text{eq/l}$ is considered the threshold for defining acid-sensitive streams and lakes.

By measuring pH, ANC, and several analytes indicative of potential acidification sources (e.g., sulfate, nitrate nitrogen, dissolved organic carbon (DOC), and agricultural land use), the Survey provides an opportunity to examine the current extent and distribution of stream acidification in Maryland watersheds. Results from the 2000 MBSS sampling are presented below.

3.3.1 Low pH

During spring 2000 sampling, sites in 6 of 18 PSUs sampled exhibited pH < 5. Sites in 10 PSUs had pH < 6. Three PSUs sampled had mean pH < 6 during spring: Nanjemoy Creek, St. Mary's River, and Lower Wicomico PSU. Spring pH values are shown in Figure 3-10. Spring pH values of individual sites are depicted in Figure 3-11. Typically, spring pH values are slightly lower than summer because of episodic acidification from spring rain events. As expected, pH tended to be slightly higher in most PSUs during summer.

Results were used to estimate the extent of low spring pH conditions within each PSU as the percentage of stream miles with pH < 6 (Figure 3-12, Appendix Table B-7). For spring 2000, the greatest extent of low pH was estimated in Nanjemoy Creek, where the 90% confidence interval indicated 39 to 91% of stream miles had pH < 6. Several other PSUs had slightly lower confidence intervals. Note that even in the eight PSUs where no pH values < 6 were observed, the upper limit of the 90% confidence interval ranged from 17 to 26%, indicating the potential for low pH conditions to exist. For summer 2000 (Appendix Table B8), the greatest extent of low pH was estimated in Lower Wicomico PSU, where the 90% confidence interval indicated 22 to 78% of stream miles had pH < 6, the same as the spring estimate for this PSU. Note that the summer 90% confidence interval for pH < 6 streams in Nanjemoy Creek decreased to 15 to 70%, reflecting seasonal differences.

3.3.2 Low Acid Neutralizing Capacity

Although pH is the most commonly used measure of acidification, ANC is a better overall measure of acidification and acid sensitivity, because it also indicates which systems are likely to become acidified under episodic conditions. The following critical ANC values are used to characterize streams according to acid sensitivity: < 0 $\mu\text{eq/l}$ (acidic), 0 < ANC < 50 $\mu\text{eq/l}$ (highly sensitive to acidification), 50 < ANC < 200 $\mu\text{eq/l}$ (sensitive to acidification), and > 200 $\mu\text{eq/l}$ (not sensitive to acidification).

ANC values measured during spring 2000 are shown in Figures 3-13 and 3-14. Eight PSUs, primarily those in Western Maryland and the Southern Coastal Plain, had sites with ANC < 50 $\mu\text{eq/l}$. As shown in Figure 3-15 (Appendix Table B-9), PSUs with the greatest estimated stream length with ANC < 50 $\mu\text{eq/l}$ were Nanjemoy Creek, Lower Wicomico PSU, Casselman River, and St. Mary's River. Estimates of the percentage of stream miles with ANC < 200 $\mu\text{eq/l}$ follow the geographic pattern noted in the MSSCS and Round One MBSS, with the greatest extent of acid-sensitive streams in Western Maryland and the Southern Coastal Plain (Figure 3-16, Appendix Table B-10).

3.3.3 Likely Sources of Acidity

In estimating the extent of acidification of Maryland streams, it is important to understand how acidic deposition, acid mine drainage, agricultural runoff, and natural organic materials contribute to the observed acidification. Acidic deposition is the contribution of material from

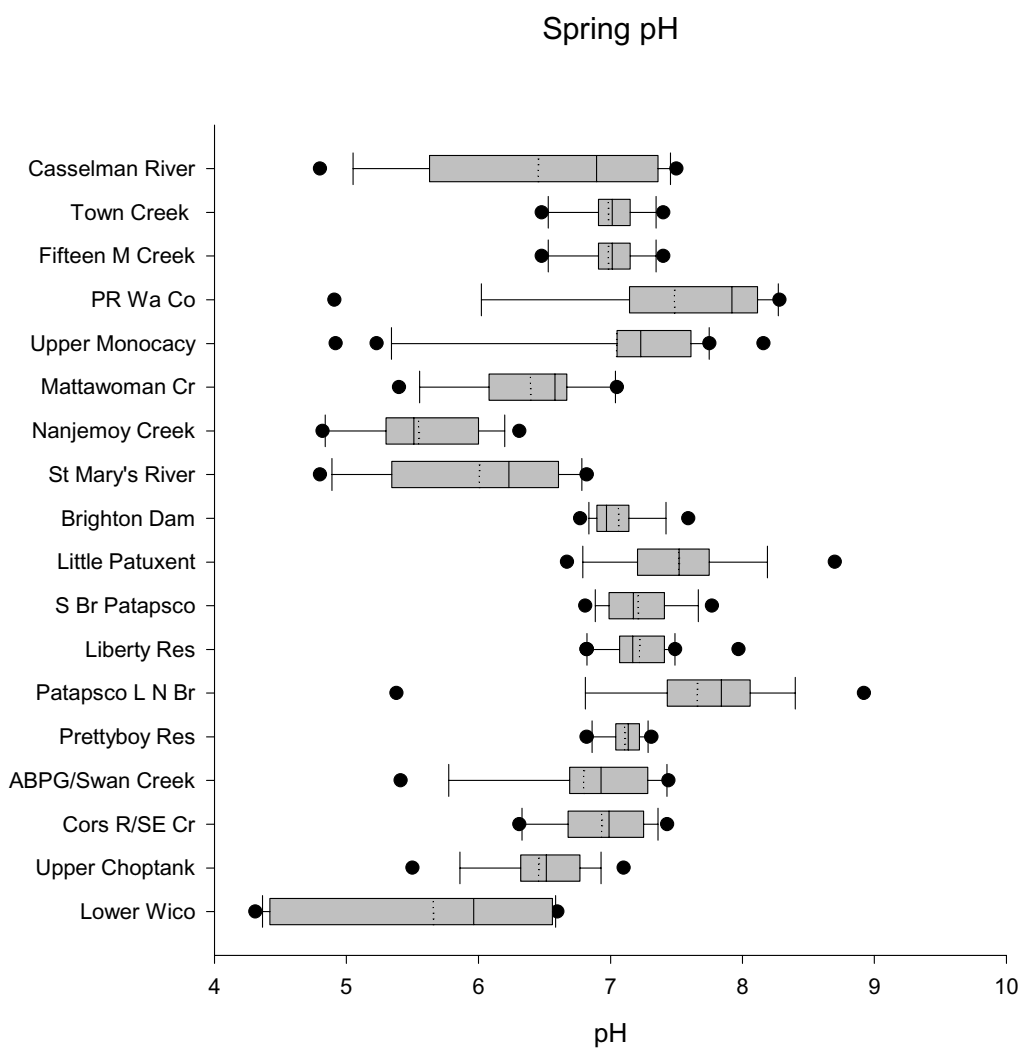


Figure 3-10. Distribution of spring pH values for the MBSS PSUs sampled in 2000

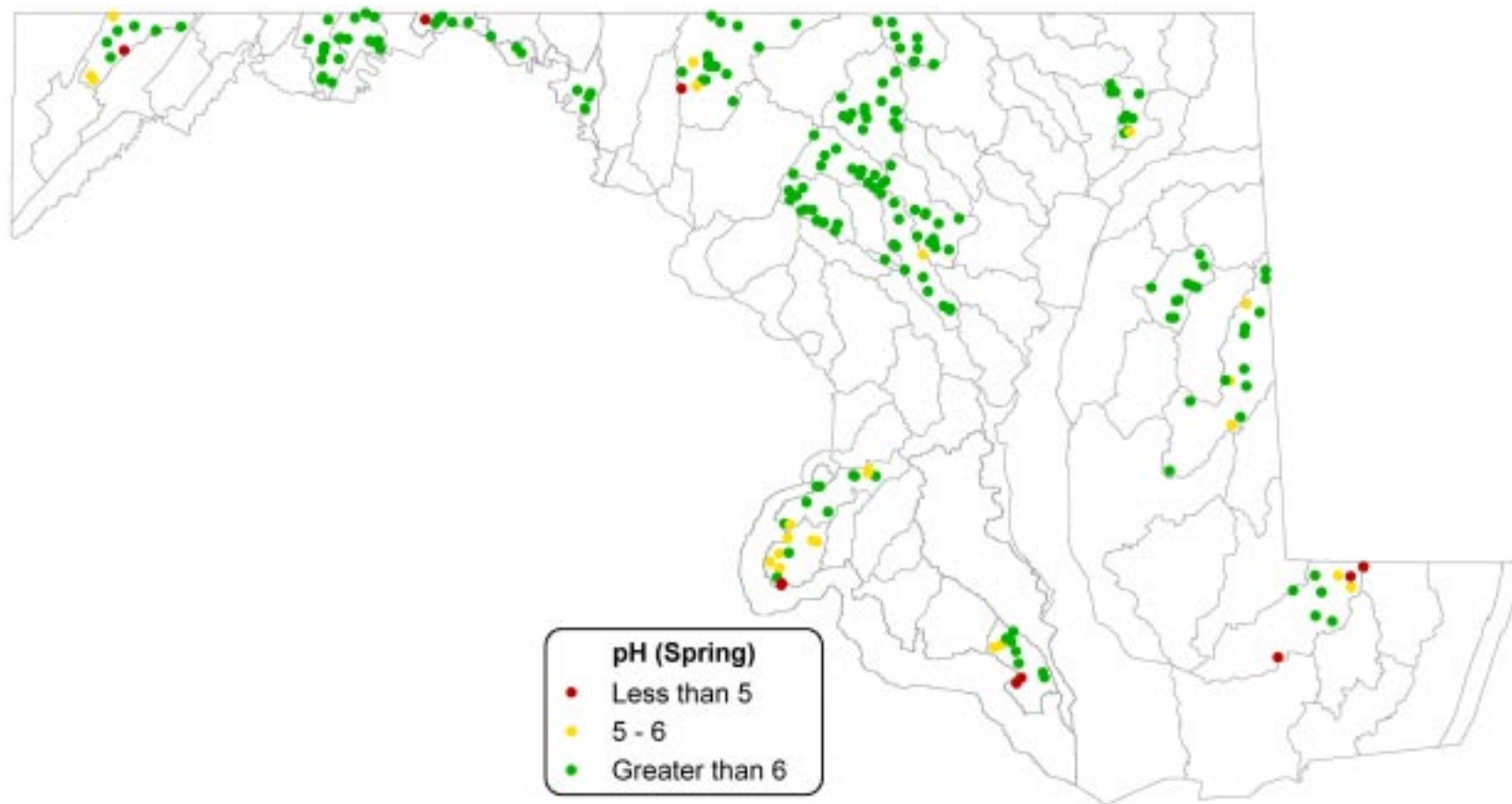


Figure 3-11. Distribution of spring pH values for sites sampled in the 2000 MBSS

Percentage of Stream Miles with Spring pH < 6

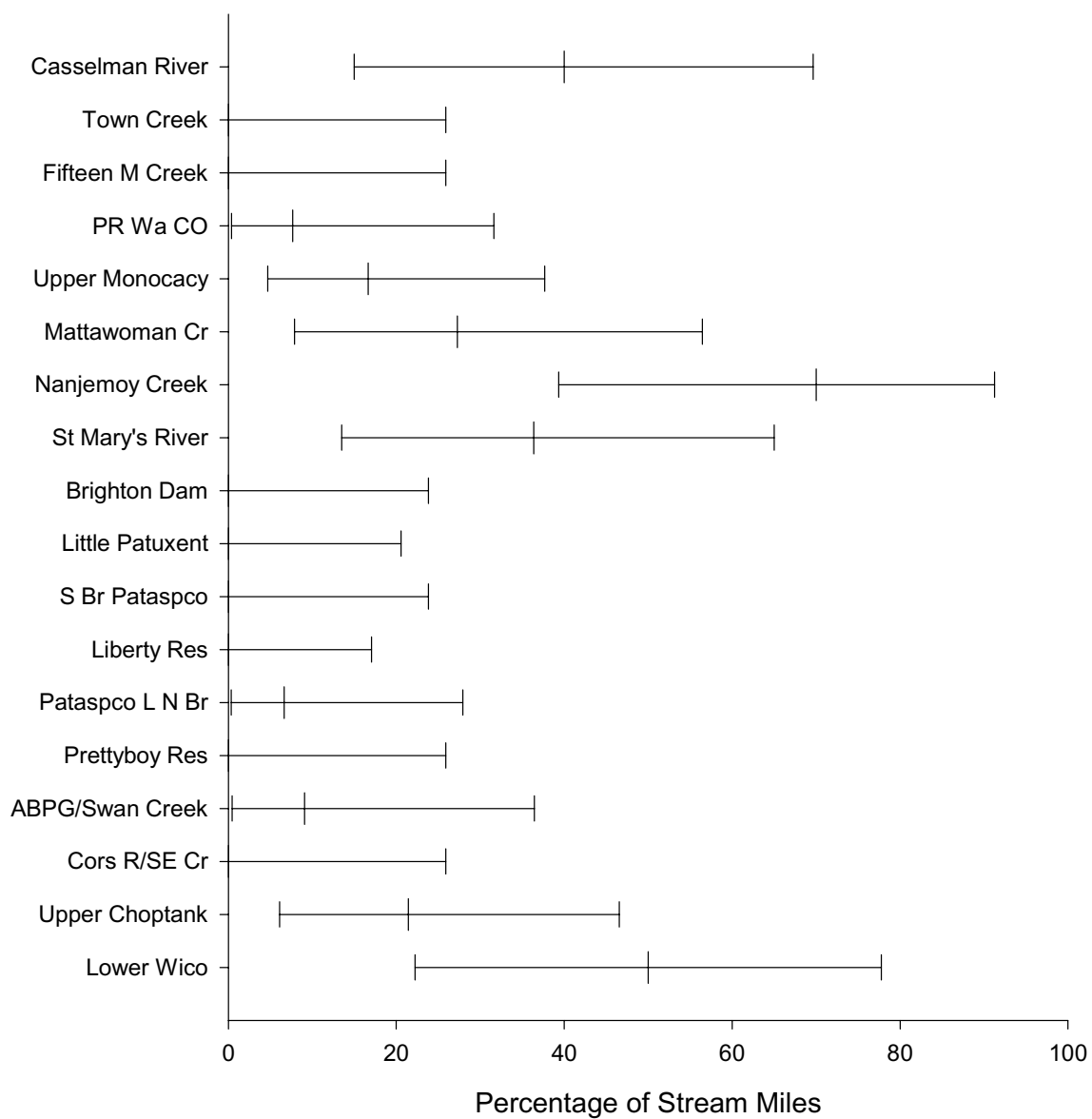


Figure 3-12. Percentage of stream miles with spring pH < 6.0

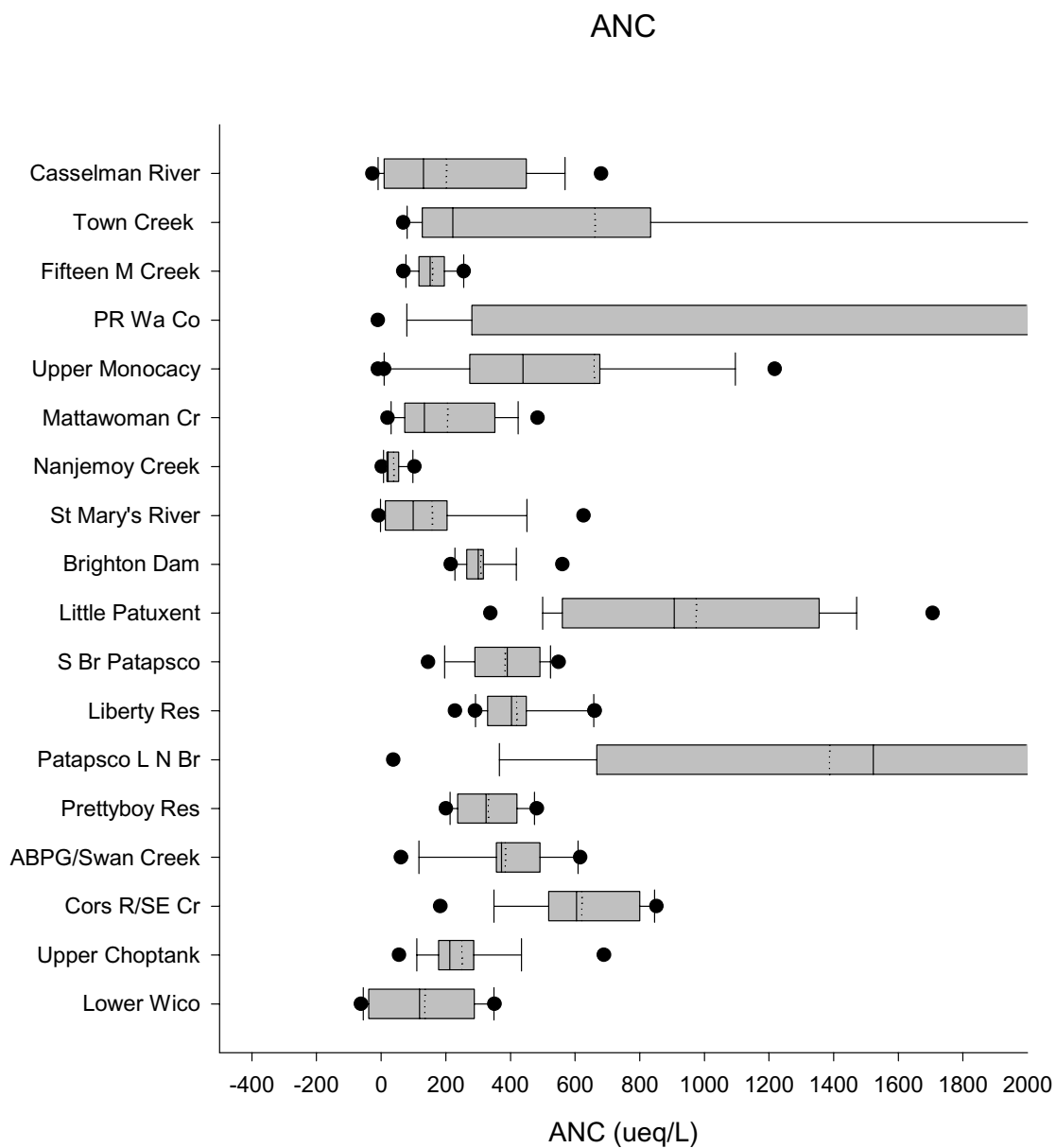


Figure 3-13. Distribution of Acid Neutralizing Capacity (ANC) values in $\mu\text{eq/L}$ for the MBSS PSUs sampled in 2000

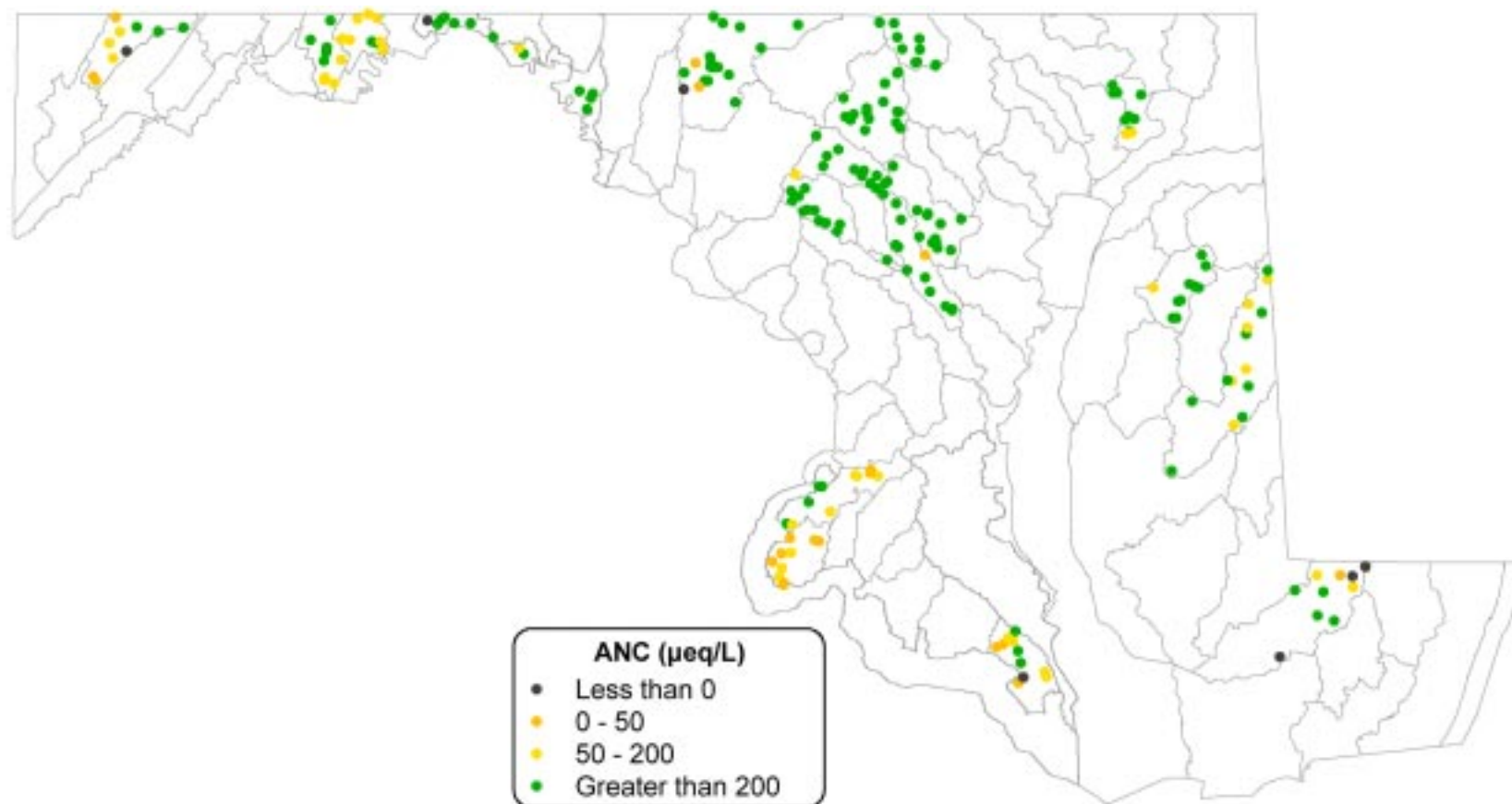


Figure 3-14. Distribution of Acid Neutralizing Capacity (ANC) values for the sites sampled in the 2000 MBSS

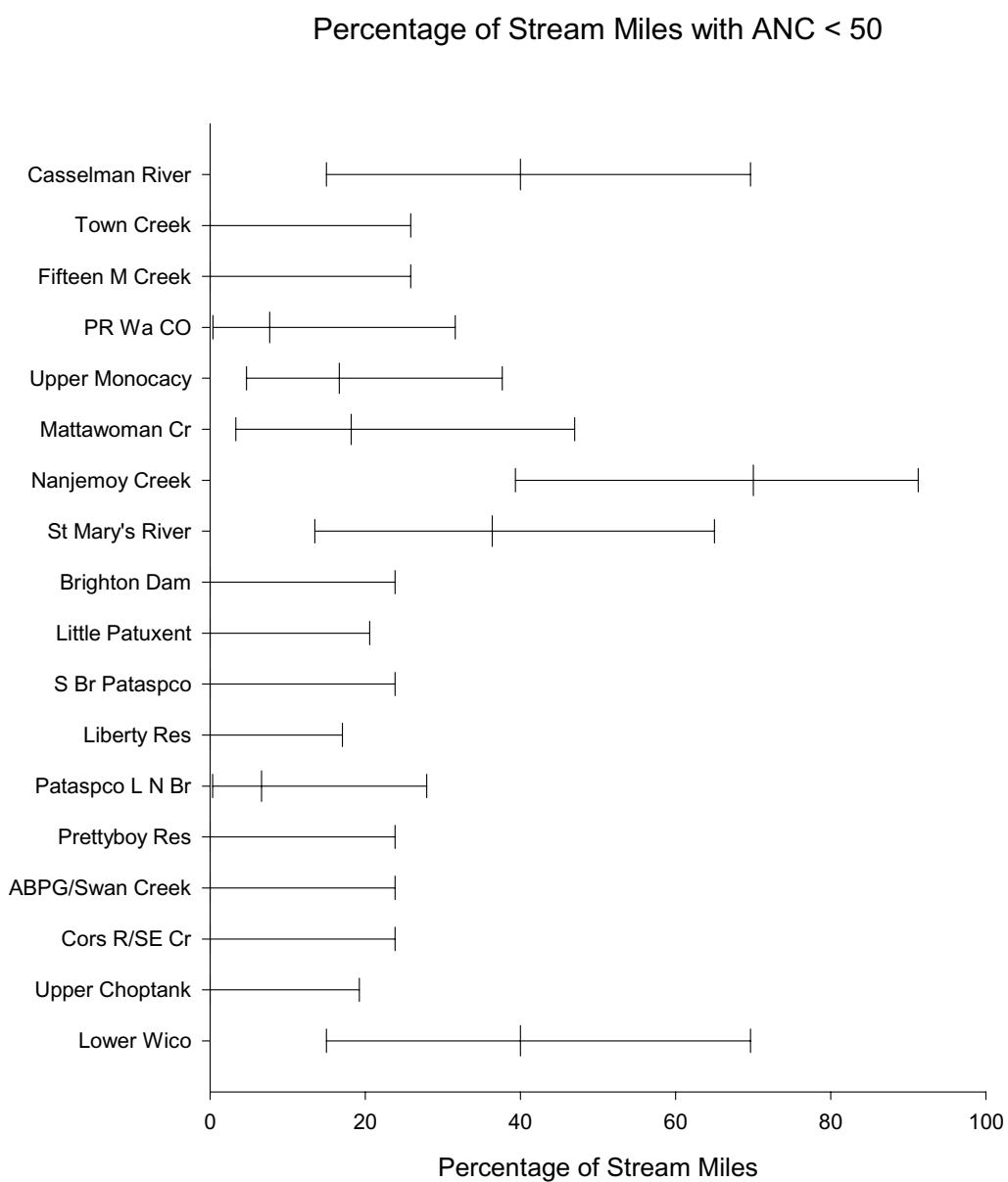


Figure 3-15. Percentage of stream miles with Acid Neutralizing Capacity (ANC) < 50 $\mu\text{eq/L}$

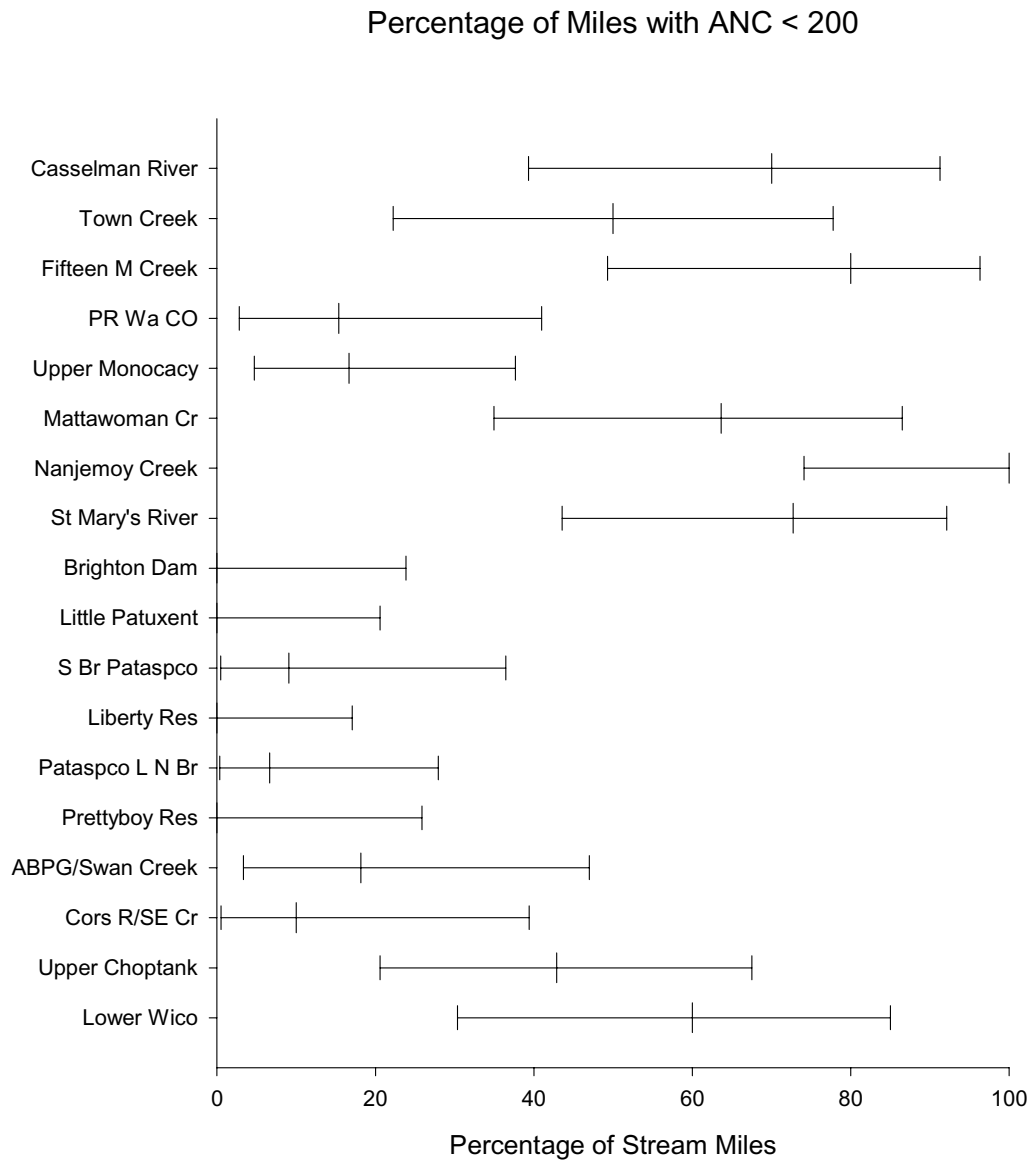


Figure 3-16. Percentage of stream miles with Acid Neutralizing Capacity (ANC) < 200 $\mu\text{eq/L}$

atmospheric sources, both as precipitation (wet) and particulate (dry) deposition. Acidic deposition is generally associated with elevated concentrations of sulfate and nitrate in precipitation. AMD results from the oxidation of iron and sulfur from mine spoils and abandoned mine shafts and is known to cause extreme acidification of surface waters. Streams strongly impacted by AMD exhibit high levels of sulfate, manganese, iron, and conductivity. A third source of acidification is surface runoff from agricultural lands that are fertilized with high levels of nitrogen or other acidifying compounds. Lastly, the natural decay of organic materials may contribute acidity in the form of organic anions, as in blackwater streams associated with bald cypress wetlands. Streams dominated by organic sources of acidity are often characterized by high concentrations of dissolved organic carbon and organic anions. Available water chemistry and land use data will be used to screen for likely acidifying sources following the method employed in Round One analysis (Roth et al. 1999).

Results of the acid source screening indicate patterns that closely follow the results found in Round One of the Survey. A total of 63 sites (approximately 30%) sampled in 2000 had $ANC < 200 \mu\text{eq/L}$, an indication of acidification or acid sensitivity. Evidence of AMD was found at one site in the Casselman River PSU, while three sites in this PSU were affected by both AMD and acidic deposition. Organic ions contributed to the acidification of several sites on the Eastern Shore and in southern Maryland: Corsica River/Southeast Creek (1 site), Lower Wicomico PSU (2 sites), Nanjemoy Creek (1 site), and Upper Choptank River (1 site). Both organic ions and acidic deposition affected sites in Aberdeen Proving Ground/Swan Creek (2 sites), Lower Wicomico PSU (4 sites), Mattawoman Creek (1 site), Nanjemoy Creek (1 site), St. Mary's River (1 site), and Upper Choptank River (3 sites). Agriculture contributed to acidification at only one site in the South Branch Patapsco River. Acidic deposition effects were more widespread, affecting PSUs throughout the State. Forty sites were affected in 10 PSUs, located mainly in western and southern Maryland: Corsica River/Southeast Creek (2 sites), Fifteen Mile Creek (8 sites), Potomac River Washington County PSU (2 sites), Mattawoman Creek (6 sites), Nanjemoy Creek (6 sites), Patapsco River Lower North Branch (1 site), St. Mary's River (6 sites), Town Creek (5 sites), Upper Monocacy River (3 sites), and Upper Choptank River (1 site). Three PSUs, located in central Maryland, showed no effects of acidification: Brighton Dam, Liberty Reservoir, and Little Patuxent River.

3.4 PHYSICAL HABITAT

Although many water resource programs tend to focus on water chemistry-based definitions of stream quality, physical habitat degradation can have an equal or greater effect on stream ecosystems and their biological communities. Habitat loss and degradation has been identified as one of six critical factors affecting biological diversity in streams worldwide (Allan and Flecker 1993). Habitat degradation can result from a variety of human impacts occurring within the stream itself and in the surrounding riparian zone and watershed. Typical instream impacts include sedimentation, impoundment, and stream channelization. Urban development, timber harvesting, agriculture, livestock grazing, and the draining or filling of wetlands are well-known examples of human activities affecting streams at a broader scale. In watersheds impacted by anthropogenic stress, riparian (streamside) forests can ameliorate inputs of nutrients, sediments, and other pollutants to streams. They also provide other functions, such as shade, overhead cover, and inputs of leaf litter and large woody debris.

The Survey collects data to assess the extent and type of physical habitat degradation occurring in Maryland streams. A provisional Physical Habitat Index (PHI), developed during MBSS Round One, was used to assess the overall status of physical habitat conditions. In addition, examination of individual parameters are useful for assessing geomorphic processes, integrity of riparian vegetation, and alterations to natural temperature regimes. Data from 2000 MBSS sampling were analyzed to examine key physical habitat parameters that may affect biological communities.

3.4.1 Physical Habitat Index

A provisional PHI, developed using earlier MBSS data (Hall et al. 1999), was used to score sites sampled in 2000. Because of underlying differences in stream types, separate PHIs are applied in each of two geographic strata: the Coastal Plain and non-Coastal Plain. Four key physical habitat variables are common to both the Coastal Plain and the non-Coastal Plain indices: (1) instream habitat structure, (2) velocity/depth diversity, (3) embeddedness, and (4) aesthetic rating (trash rating). Two additional variables are important in the Coastal Plain – pool/glide/eddy quality and maximum depth. Two other variables are included in the non-Coastal Plain – riffle/run quality and number of rootwads in a stream reach.

Index scores are adjusted to a centile scale that rates each sample segment as follows:

- Scores of 72 to 100 are rated good
- Scores of 42 to 71.9 are rated fair
- Scores of 12 to 41.9 are rated poor
- Scores of 0 to 11.9 are rated very poor

Scores for MBSS 2000 sampling were computed by comparison with the same distributions of metric values that were used to develop the PHI. Thus indicator scores may be interpreted using the same narrative ratings employed in Round One.

Provisional PHI results by PSU are shown in Figure 3-17 and Appendix Table B-11. Scores varied widely within and among PSUs. The mean PHI was fell into the range of good in six PSUs, all in central and southern Maryland (Mattawoman, St. Mary's River, Brighton Dam, Little Patuxent, Liberty Reservoir, and Prettyboy Reservoir). Mean PHI was poor in three PSUs (Town Creek, Aberdeen Proving Ground/Swan Creek, and Lower Wicomico PSU) and fair in the remaining nine PSUs. The geographic distribution of PHI scores is shown on a statewide map (Figure 3-18).

Stream mile estimates of the occurrence of poor to very poor PHI scores suggest that physical habitat degradation is widespread (Figure 3-19, Appendix Table B-12). The greatest extent of low PHI scores was within Aberdeen Proving Ground/Swan Creek PSU, where the 90% confidence interval predicted that 45 to 96% of stream miles were in poor to very poor condition.

3.4.2 Geomorphic Processes

Channelization can substantially alter the character of the stream. Historically, streams were commonly channelized to drain fields and to provide flood control. Today, streams in urban areas are often channelized to accommodate road-building or to drain stormwater from developed areas. When previously meandering streams are straightened, they lose their natural connection to the floodplain, with significant adverse consequences for the stream ecosystem. For example, increased flows during storm events can lead to greater scouring, greater bank instability, and disruption of the natural pattern of riffle and pool habitats. At other times, decreased baseflows can result in stagnant ditches with substrates degraded by heavy sediment deposition.

MBSS 2000 results indicate that stream channelization is common in some Maryland watersheds, particularly in the

Coastal Plain (Figure 3-20, Appendix Table B-13). The most widespread incidence of channelization was observed in Upper Choptank (90% confidence interval: 26 to 74% of stream miles channelized), Aberdeen Proving Ground/Swan Creek (25 to 75% of stream miles), Lower Wicomico PSU (20 to 72% of stream miles) and Patapsco Lower North Branch (18 to 61% of stream miles) PSUs.

Bank erosion is a common symptom of stream problems. Erosion within the stream channel, often associated with "flashy" flow regimes in highly urbanized watersheds, can scour banks and mobilize sediment. In fact, much of the sediment transported and deposited within the stream often originates from in-channel erosion rather than overland flow. Bank erosion can be a signal of channel instability (side-cutting) when a stream becomes entrenched (i.e., cannot reach its floodplain during high flow events). While the lack of streambank vegetation can contribute to bank erosion, severe erosion can in turn destabilize vegetation, causing even large trees to fall.

Moderate to severe bank erosion occurs commonly in Maryland streams, as seen in MBSS 2000 sampling results (Figure 3-21, Appendix Table B-14). Many watersheds had high occurrence of bank erosion. The greatest extent of moderate to severe bank erosion was estimated for Little Patuxent (90% confidence interval: 68 to 100% of stream miles) and Brighton Dam (64 to 100% of stream miles) PSUs.

Within each 75-meter segment sampled, field estimates of the amount of eroded bank area were made. Moderate to severe erosion was included in analysis. Mean values by PSU were used to estimate the extent of eroded area (square meters) per stream mile. The highest values were in Little Patuxent, Brighton Dam, and South Branch Patapsco PSUs. Per-mile areas were then used to project the total surface area of bare, eroded bank in each PSU (Table 3-3). Combined, the eroded bank area in these 18 PSUs totals nearly 400 acres.

Significant deposition of gravel and fine sediments can lead to mid-channel bar formation. Although some formation of bars is natural, more severe bar formation can signal channel instability related to bank erosion and altered flow regimes. Such streams typically have poor habitat for stream biota because substrate shifts with each high flow event. Sediments can become resuspended, increasing turbidity.

Exacerbated bar formation was observed in most watersheds sampled in 2000 (Figure 3-22, Appendix Table B-15). Estimates of the percentage of stream miles experiencing

Physical Habitat Indicator

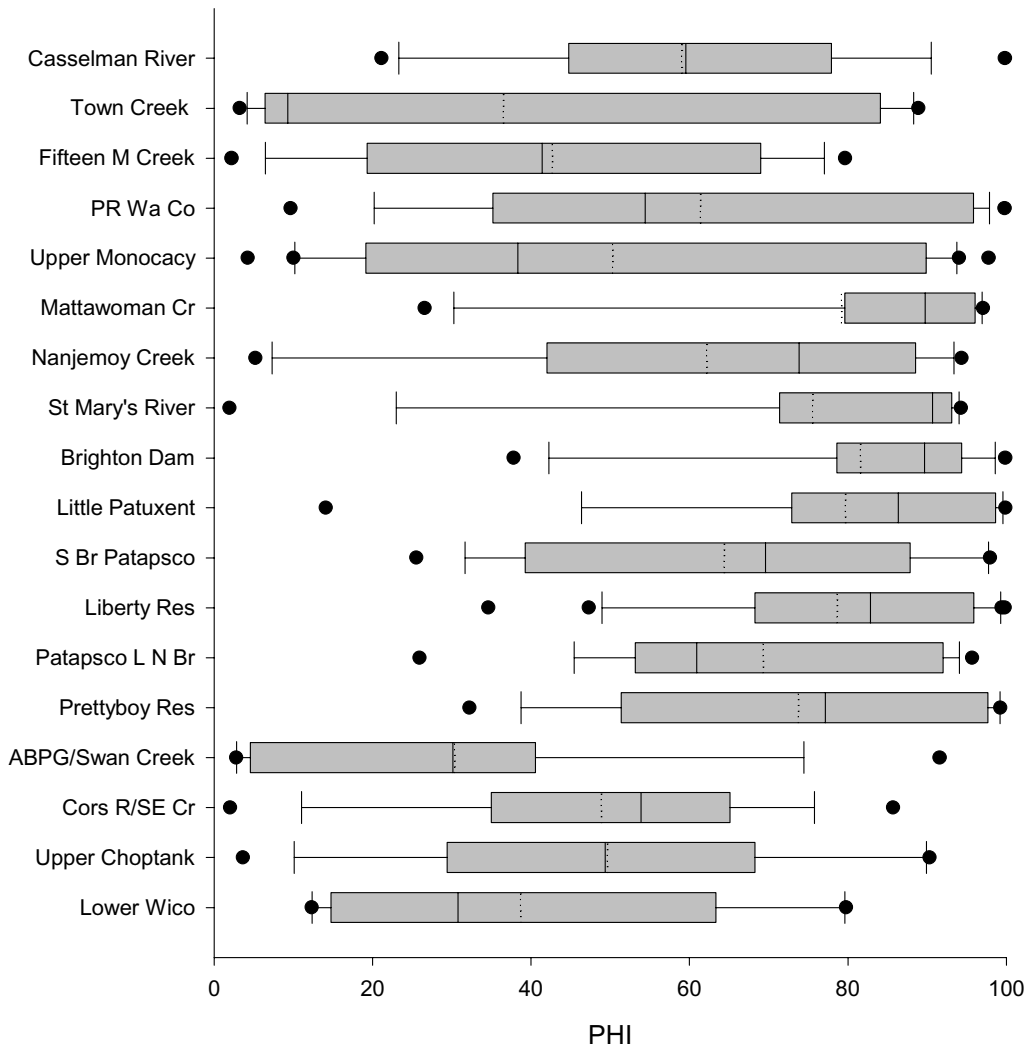


Figure 3-17. Distribution of Physical Habitat Indicator (PHI) scores for the MBSS PSUs sampled in 2000

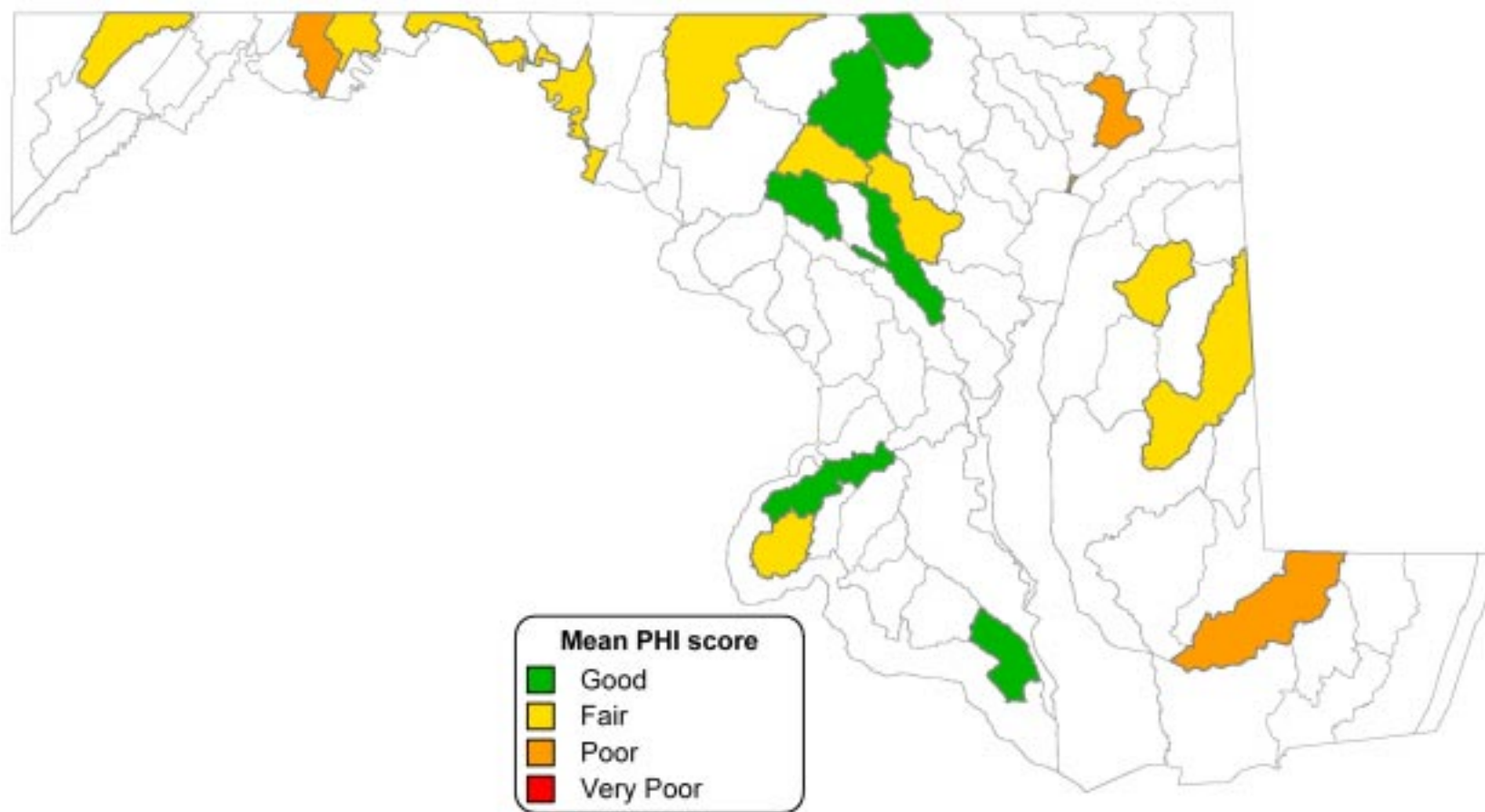


Figure 3-18. Mean Physical Habitat Indicator (PHI) scores for the MBSS PSUs sampled in 2000

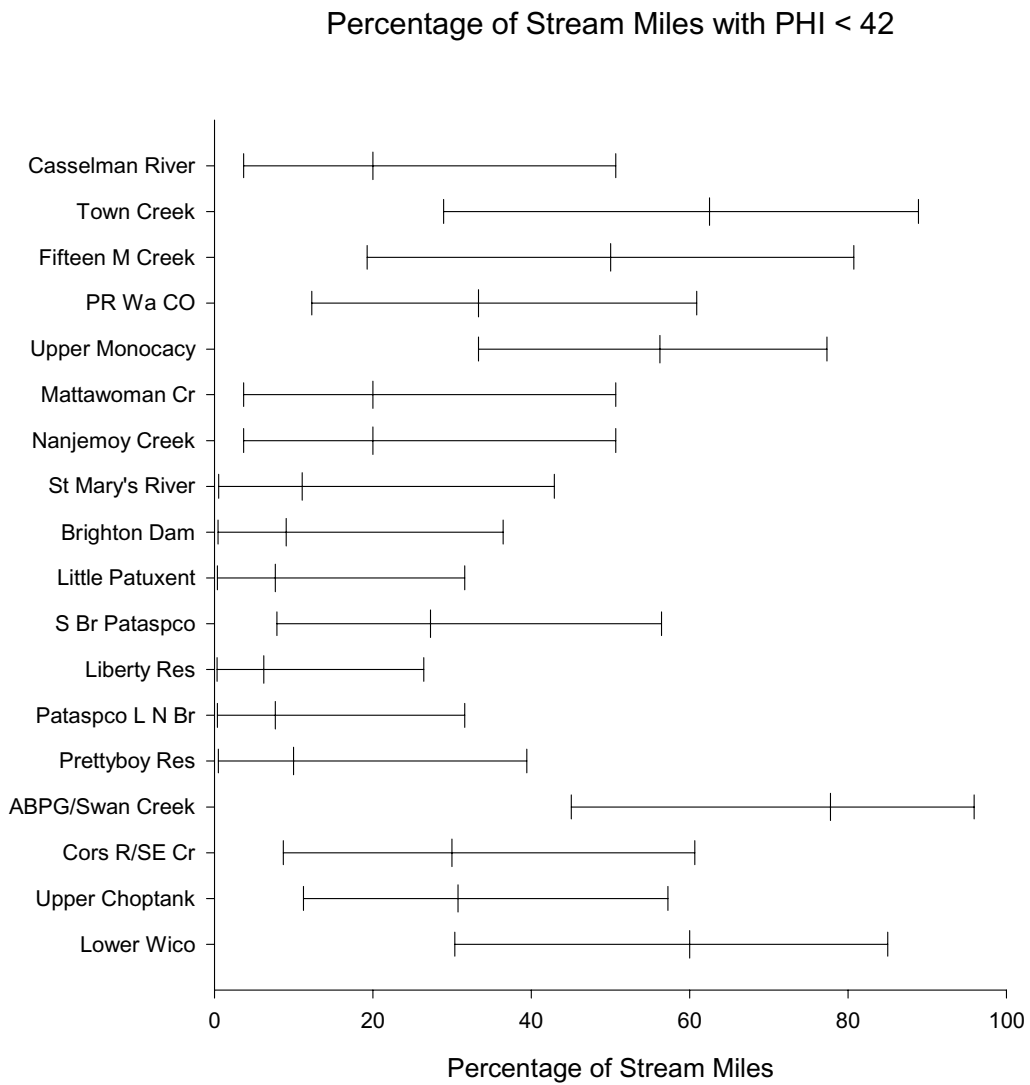


Figure 3-19. Percentage of stream miles with Physical Habitat Indicator (PHI) scores < 42

Percentage of Stream Miles Channelized

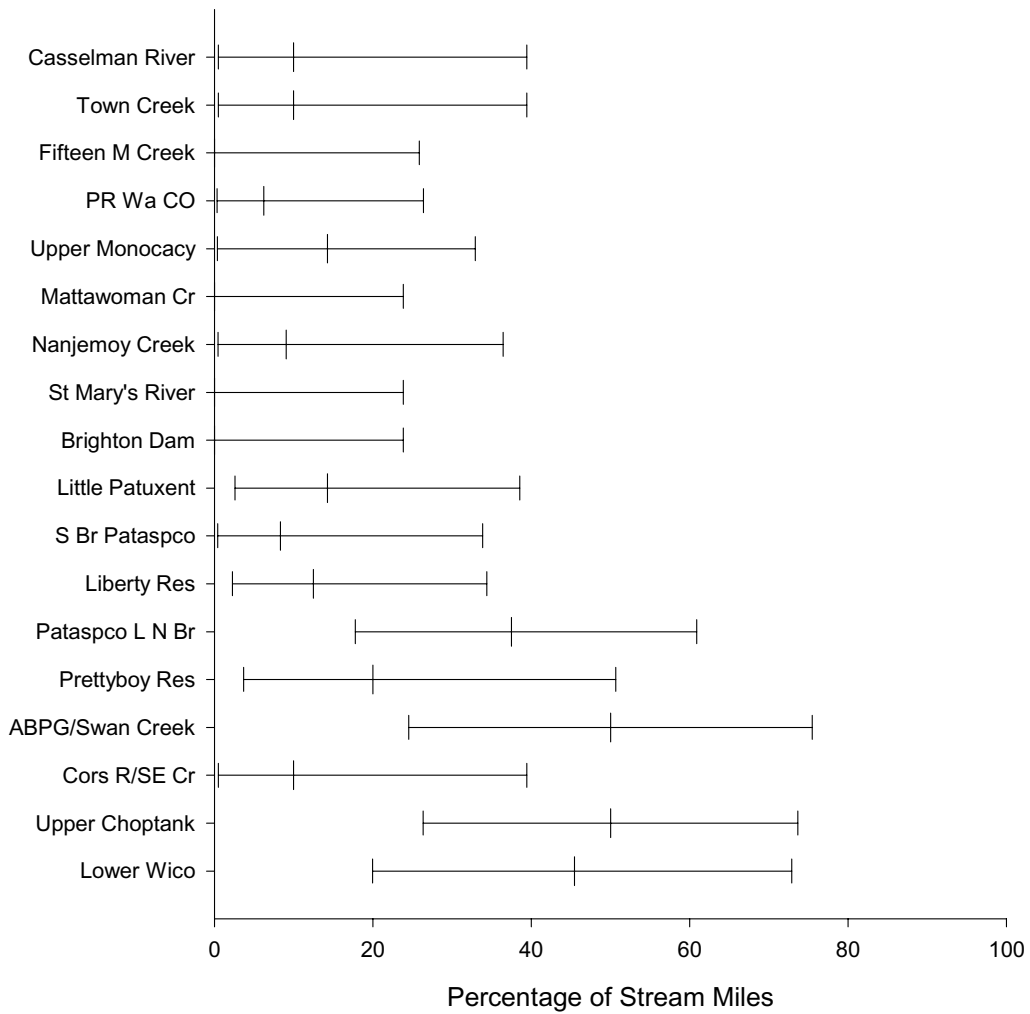


Figure 3-20. Percentage of stream miles channelized for the MBSS PSUs sampled in 2000

Percentage of Stream Miles with Moderate to Severe Bank Erosion

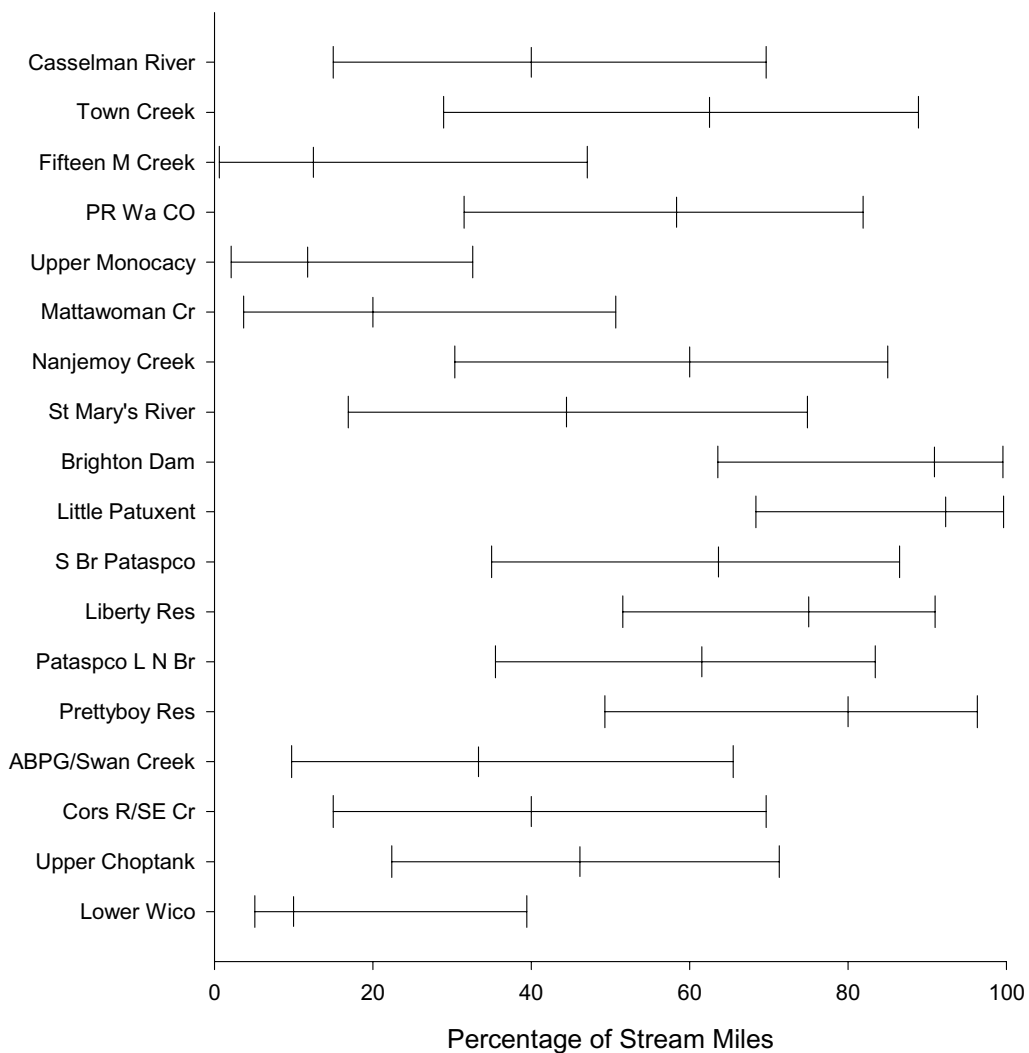


Figure 3-21. Percentage of stream miles with moderate to severe bank erosion for the MBSS PSUs sampled in 2000

Percentage of Stream Miles with Moderate to Extensive Bar Formation

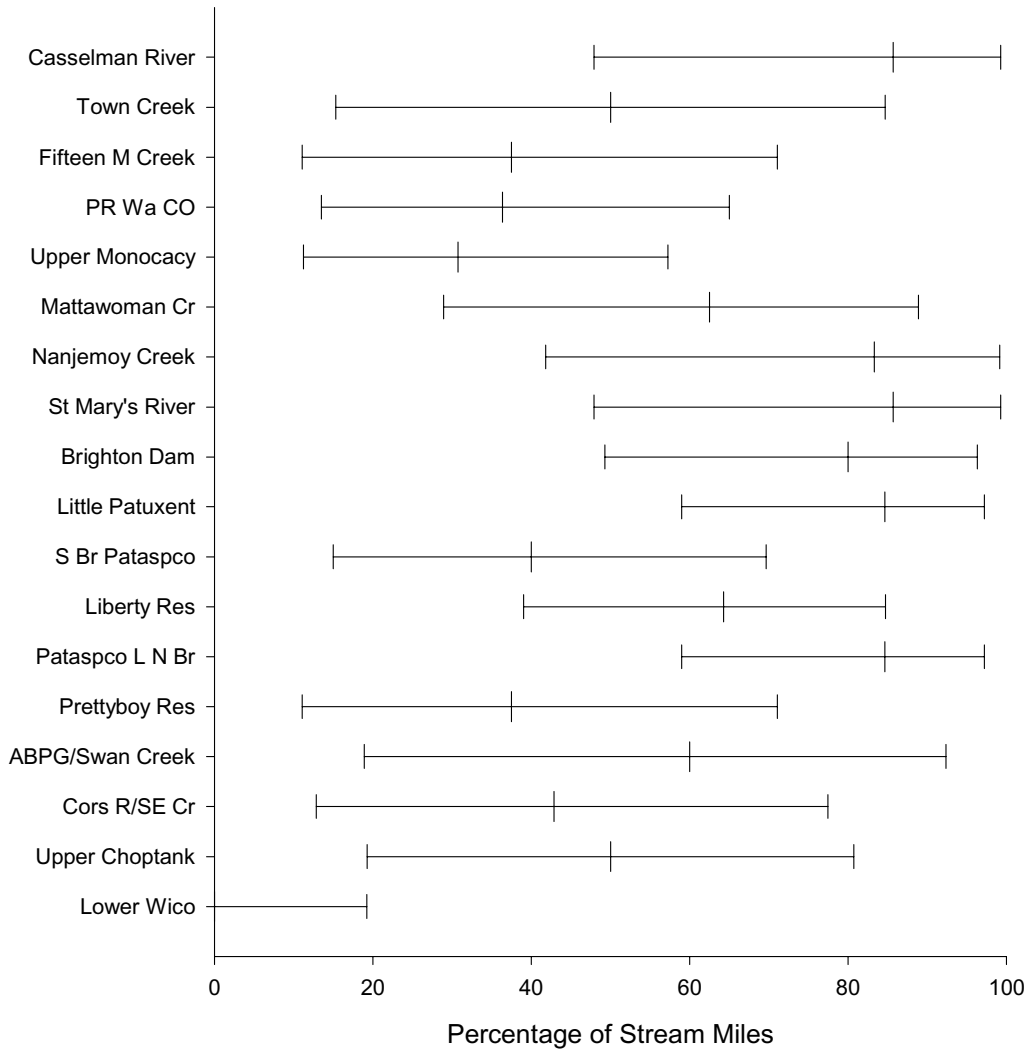


Figure 3-22. Percentage of stream miles with moderate to extensive bar formation for the MBSS PSUs sampled in 2000

Table 3-3. Eroded streambank area by stream mile and total eroded streambank area per PSU			
PSU	Mean Eroded Area (m2) per Mile	Number of Stream Miles in PSU	Total Eroded Area (acres)
Casselman River	298.7	88.5	6.5
Town Creek	960.0	125.4	29.7
Fifteen Mile Creek	133.3	81.3	2.7
Potomac River WA County/Marsh Run/Tonoloway/Little Tonoloway	746.7	119.6	22.1
Upper Monocacy River	138.0	246.4	8.4
Mattawoman Creek	170.7	86.3	3.6
Nanjemoy Creek	576.0	140.2	19.9
St. Mary's River	403.0	75.7	7.5
Brighton Dam	1881.2	98.4	45.7
Little Patuxent River	2199.0	91.5	49.7
South Branch Patapsco River	1429.3	118.3	41.8
Liberty Reservoir	653.3	184.0	29.7
Patapsco River Lower North Branch	919.0	102.8	23.3
Prettyboy Reservoir	853.3	78.4	16.5
Aberdeen Proving Ground/Swan Creek	260.7	54.0	3.5
Corsica River/Southeast Creek	810.7	72.0	14.4
Upper Choptank	672.8	277.0	46.0
Lower Wicomico/Monie Bay/Wicomico Creek/Wicomico River Head	64.0	149.8	2.4

moderate to severe bar formation were highest in Casselman River and St. Mary's River (90% confidence interval: 48 to 99% of stream miles in each PSU), Little Patuxent and Patapsco Lower North Branch (59 to 97% of stream miles in each PSU), Nanjemoy Creek (42 to 99% of stream miles), and Brighton Dam (49 to 96% of stream miles).

3.4.3 Vegetated Riparian Buffers and Woody Debris

A complete characterization of stream habitat goes beyond in-channel measures and includes the riparian zone adjacent to the stream. The effectiveness of the riparian buffer in mitigating nutrient loading and providing other benefits to the stream varies with the type and amount of riparian vegetation. MBSS records data on both the type and extent of local riparian vegetation, estimated as the functional width of the riparian buffer along each side of the 75-m sample segment.

Lack of riparian vegetation on at least one stream bank was observed within 12 of 18 PSUs sampled. Data were used to

estimate the percentage of stream miles lacking riparian buffer vegetation on at least one bank (Figure 3-23) or on both banks (Figure 3-24) (Appendix Tables B-16 and B-17).

The presence of non-native plant species is another indication of the integrity of the riparian plant community. Invasive species such as multiflora rose, mile-a-minute, and Japanese honeysuckle can crowd out native plants. Watersheds of Central Maryland and the Eastern Shore appeared particularly affected by the presence of exotic plants (Figure 3-25, Appendix Table B-18). In cases of high abundance along streams, these species can prevent natural regeneration and/or growth of intentionally planted trees and are thus a threat to buffer reestablishment.

Rootwads and other types of woody debris provide habitat, cover, and shade for a variety of stream biota. When riparian forests are removed, this important source of woody debris is lost. To assess the availability of this key habitat feature, the numbers of rootwads and other woody debris within each 75-m segment were recorded by MBSS field crews. The total number of instream pieces of woody debris

Percentage of Stream Miles with No Riparian Buffer on at Least One Bank

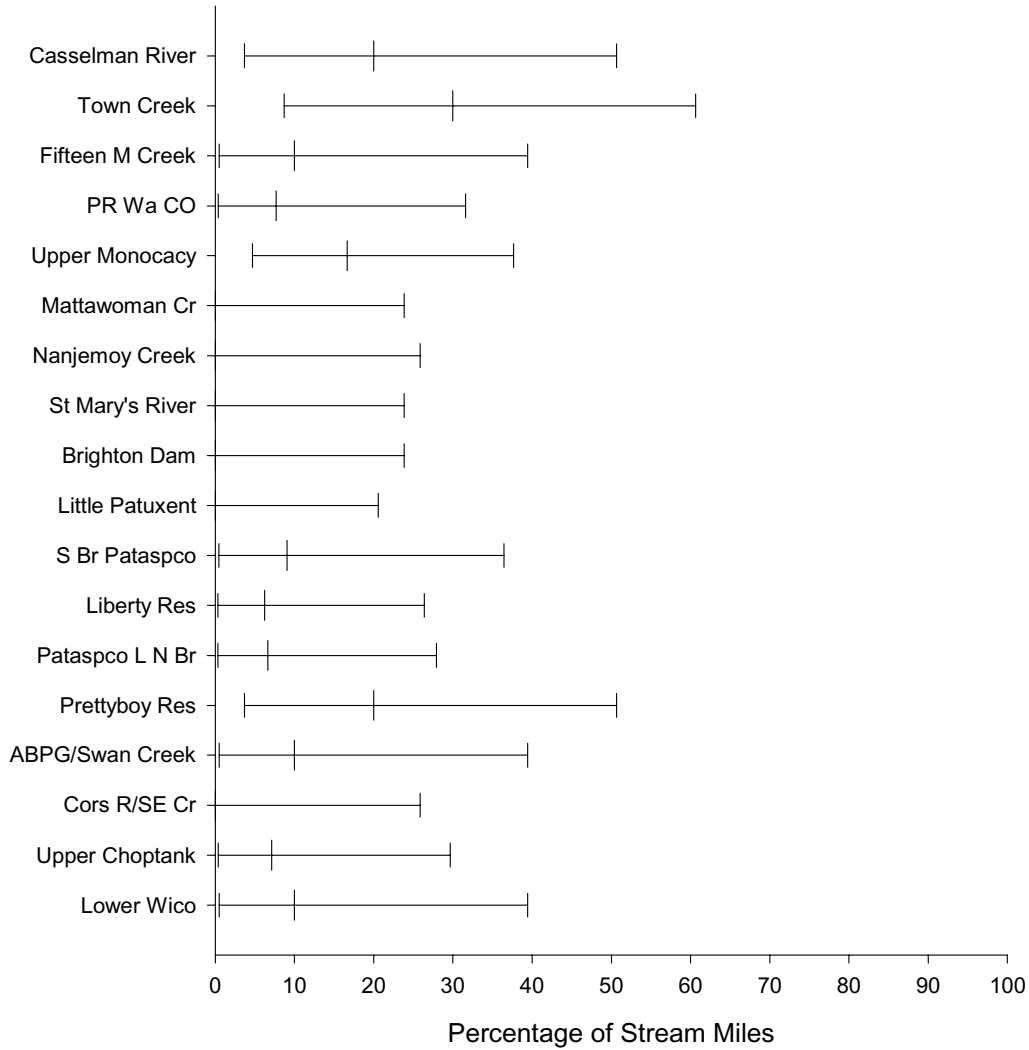


Figure 3-23. Percentage of stream miles with no riparian buffer on at least one bank for the MBSS PSUs sampled in 2000

Percentage of Stream Miles with No Riparian Buffer on Both Banks

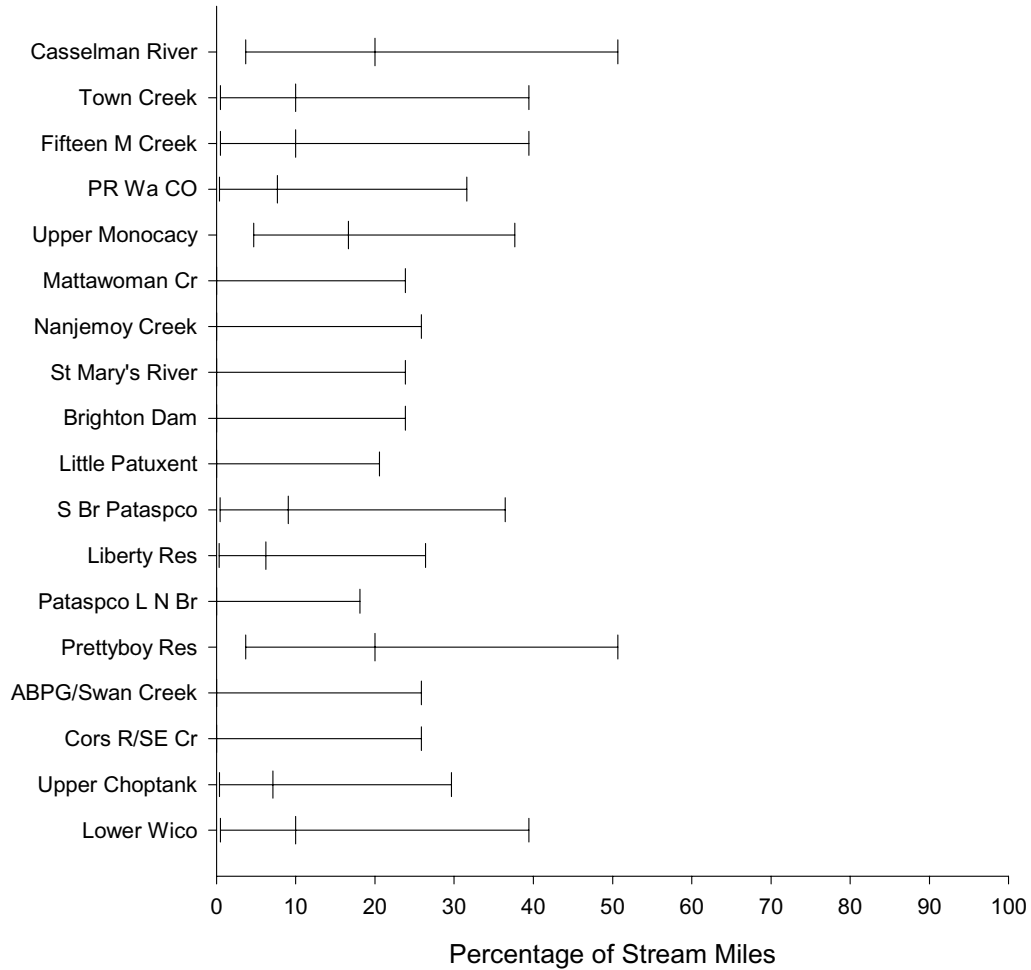


Figure 3-24. Percentage of stream miles with no riparian buffer on both banks for the MBSS PSUs sampled in 2000

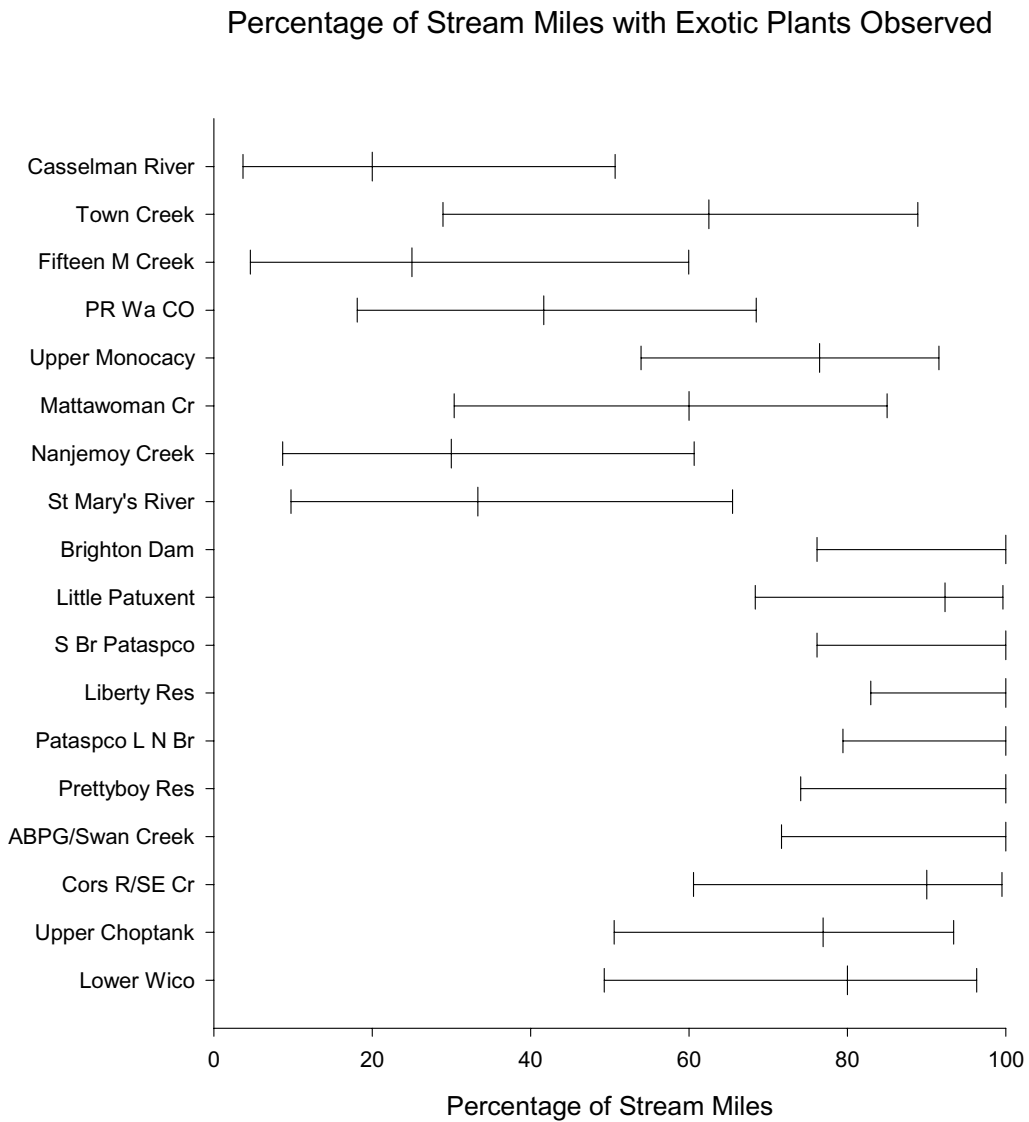


Figure 3-25. Percentage of stream miles with exotic plants observed for the MBSS PSUs sampled in 2000

and rootwads was substantially higher in Lower Wicomico PSU than elsewhere (Figure 3-26, Appendix Table B-19). Along with wood found within the wetted width of the stream itself, other in-channel (but dewatered) woody debris is a potential future source of habitat. Separate results for instream, dewatered, and total counts of woody debris and rootwads are shown in Figures 3-27 to 3-32 (Appendix Tables B-20 to B-25). The amount of rootwads and large woody debris in Maryland streams is expected to grow over time as forestry professionals continue to recognize the critical role that wood plays in stream health.

3.4.4 Temperature

During 2000, MBSS deployed continuous reading temperature loggers at more than 200 sites. The long-term goal is to use temperature data to (1) better classify and characterize coldwater streams and (2) identify streams stressed by temperature changes, such as spikes from rapid inputs of warm water running off impervious surfaces during summer storms. Initial data analyses consisted of a quality assurance review (to exclude sites where temp loggers were lost or not submerged in the stream during low flow periods), establishment of a consistent period of record, and computation of several summary indicators. Indicators were calculated for 164 sites where the data record was complete. Generally the period of record considered was June 1 to August 15, although some exceptions were made (e.g., to include sites where monitoring began between June 1 and 15). Data were recorded at 20-minute intervals with loggers set to record the highest value observed during each 20 minute interval.

Summary indicators included:

- Mean average daily temperature
- Mean minimum and maximum daily temperatures
- Absolute maximum temperature
- 95th percentile temperature
- Percentage of readings exceeding thresholds in state water quality standards

Maryland water quality standards for temperature state that the maximum temperature may not exceed 32 °C (90 °F) in most waters, 20 °C (68 °F) in Class III Natural Trout Waters, or 23.9 °C (75 °F) in Class IV Recreational Trout Waters (COMAR 1995).

Results for sites monitored in 2000 are listed in Appendix C. Among all sites assessed, mean average daily temperatures ranged from 13.7 to 24.5 °C, indicating the presence of both coldwater and warmwater sites in the data set. The

lowest mean daily minimum was 13.3 °C at a first-order site in Casselman River watershed, where coldwater conditions are common. Future analyses of data from coldwater streams will assist in interpretation of IBI scores and will contribute to development of a fish IBI tailored to these systems. Trout and several non-game species require cool to cold waters. For example, EPA criteria for growth and survival of brook trout (Maryland's only native salmonid) are maximum weekly means of 19 and 24 °C. Research has found a still lower temperature of 14.4 °C as the maximum temperature for juvenile growth of brook trout (EPA 1976 and McCormick et al. 1972, as cited in Eaton et al. 1995).

Four sites had occasional readings above 32 °C, but none more often than 0.5% of the time. A systematic review of whether any Class III or IV streams exceeded standards would require examination of site data by stream class and was beyond the scope of this report.

Examples of daily temperature data from coldwater and warmwater sites are shown in Figures 3-33 and 3-34.

3.5 NUTRIENTS AND OTHER WATER CHEMISTRY

Nutrients such as nitrogen and phosphorus are important for life in all aquatic systems. In the absence of human influence, streams contain background levels of nutrients that are essential to the survival of the aquatic plants and animals in that system. However, during the last several hundred years, the amount of nutrients transported to many stream systems has increased greatly as a result of anthropogenic influences such as agricultural runoff, wastewater discharge, urban/suburban nonpoint sources, and atmospheric deposition.

Excessive nitrogen and phosphorus loading may lead to eutrophication, particularly in downstream estuaries. Eutrophication often decreases the level of dissolved oxygen available to aquatic organisms. Prolonged exposure to low dissolved oxygen values can suffocate biota or lead to reduced condition. Increased nutrient loads are also thought to be harmful to humans by causing toxic algal blooms and contributing to outbreaks of toxic organisms such as *Pfiesteria piscicida*. In Maryland, concern for nutrient loadings to the Chesapeake Bay has drawn attention to the amounts of materials transported from throughout the watershed by stream tributaries.

The Survey provides a large dataset that can be used to assess nutrient concentrations under spring baseflow conditions. Although a full understanding of nutrient

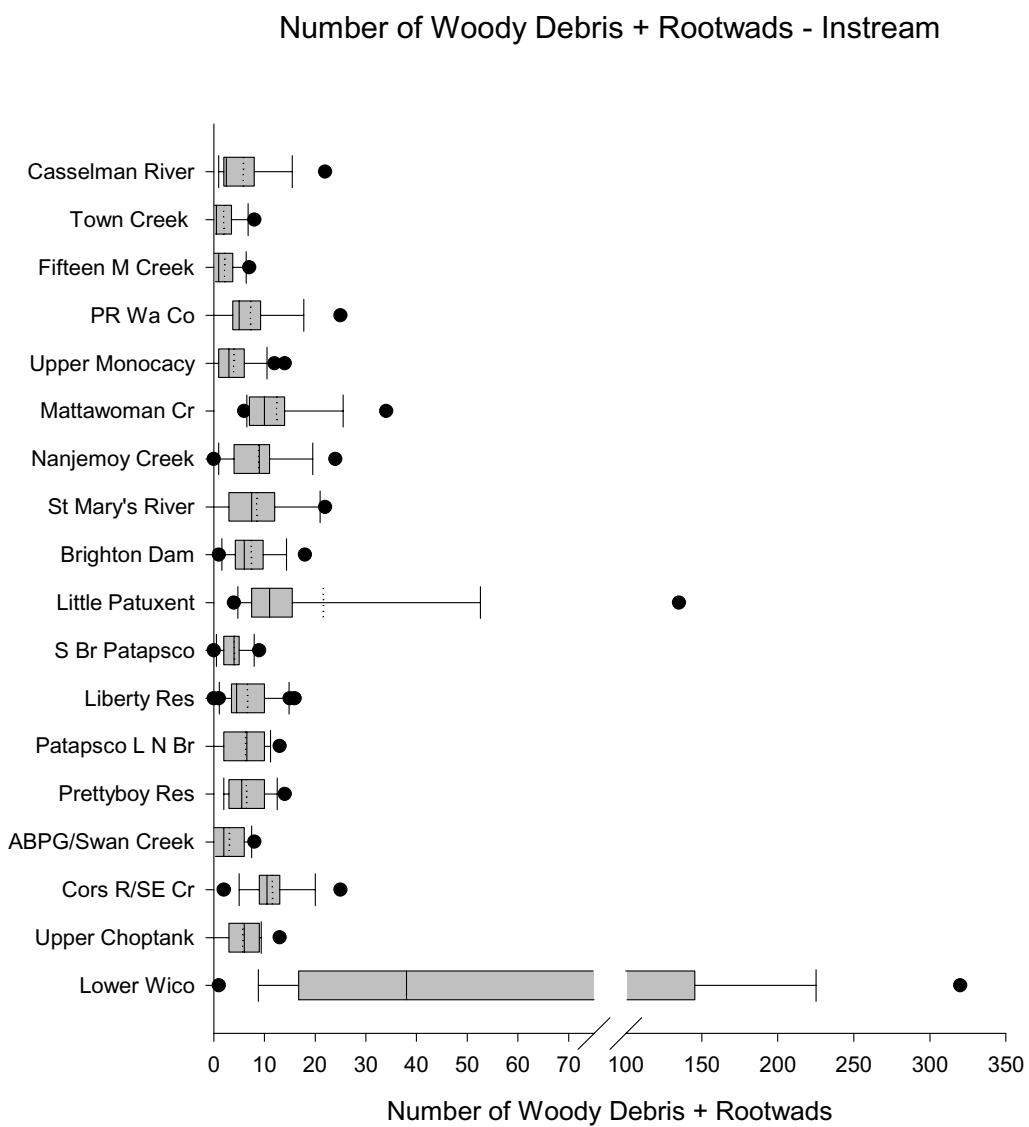


Figure 3-26. Distribution of the sum of the total number of instream woody debris and the total number of instream rootwads for the MBSS PSUs sampled in 2000

Woody Debris - Instream

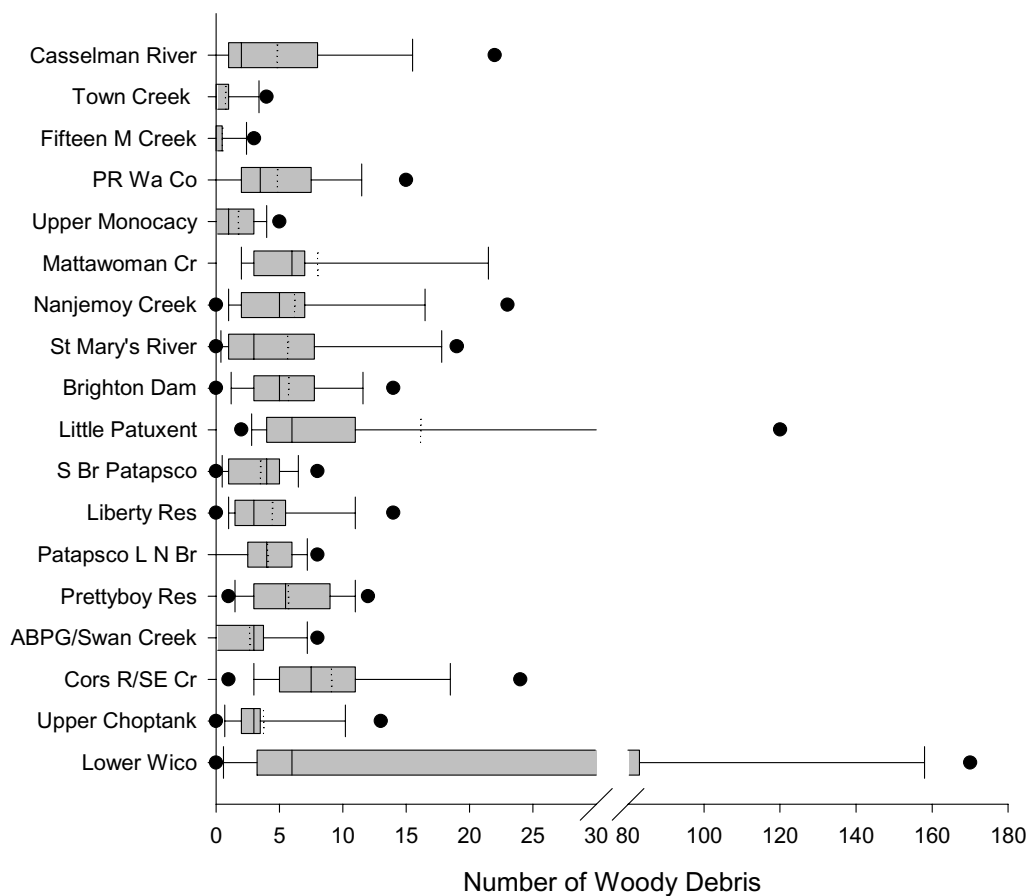


Figure 3-27. Distribution of the number of instream woody debris for the MBSS PSUs sampled in 2000

Woody Debris - Dewatered

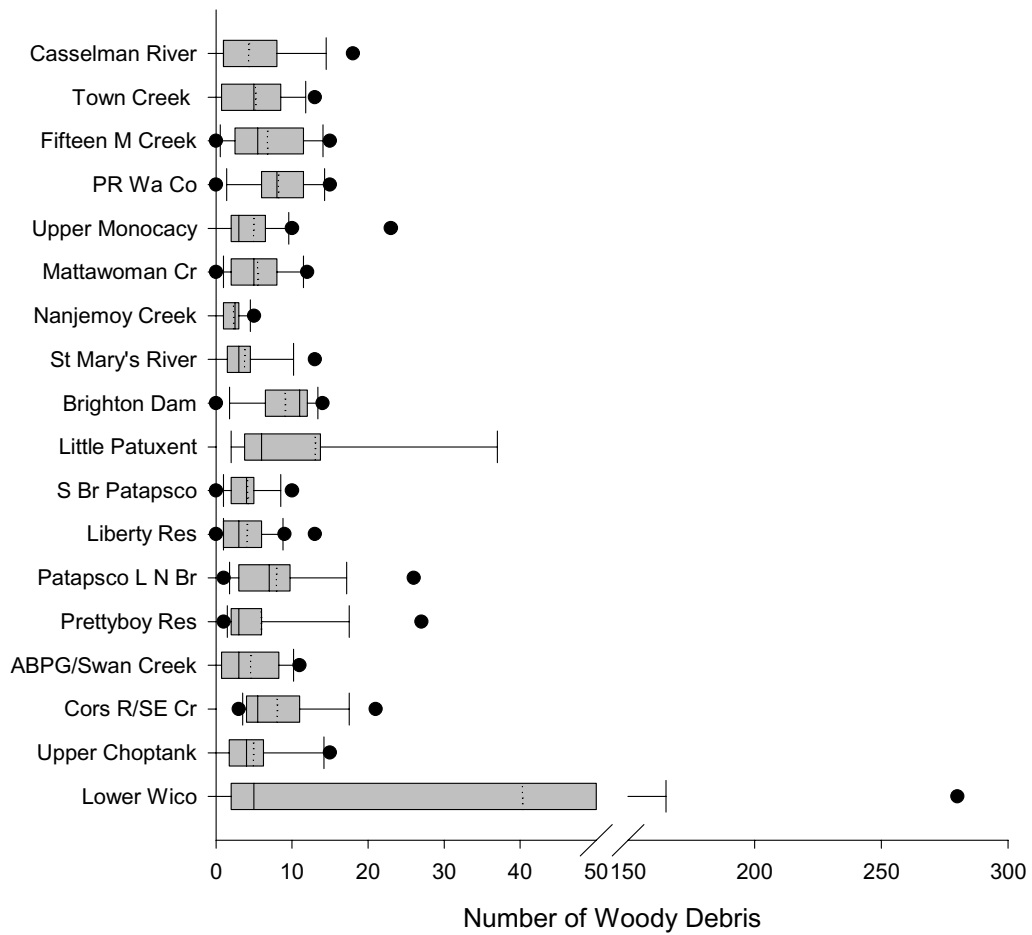


Figure 3-28. Distribution of the number of dewatered woody debris for the MBSS PSUs sampled in 2000

Woody Debris - Total

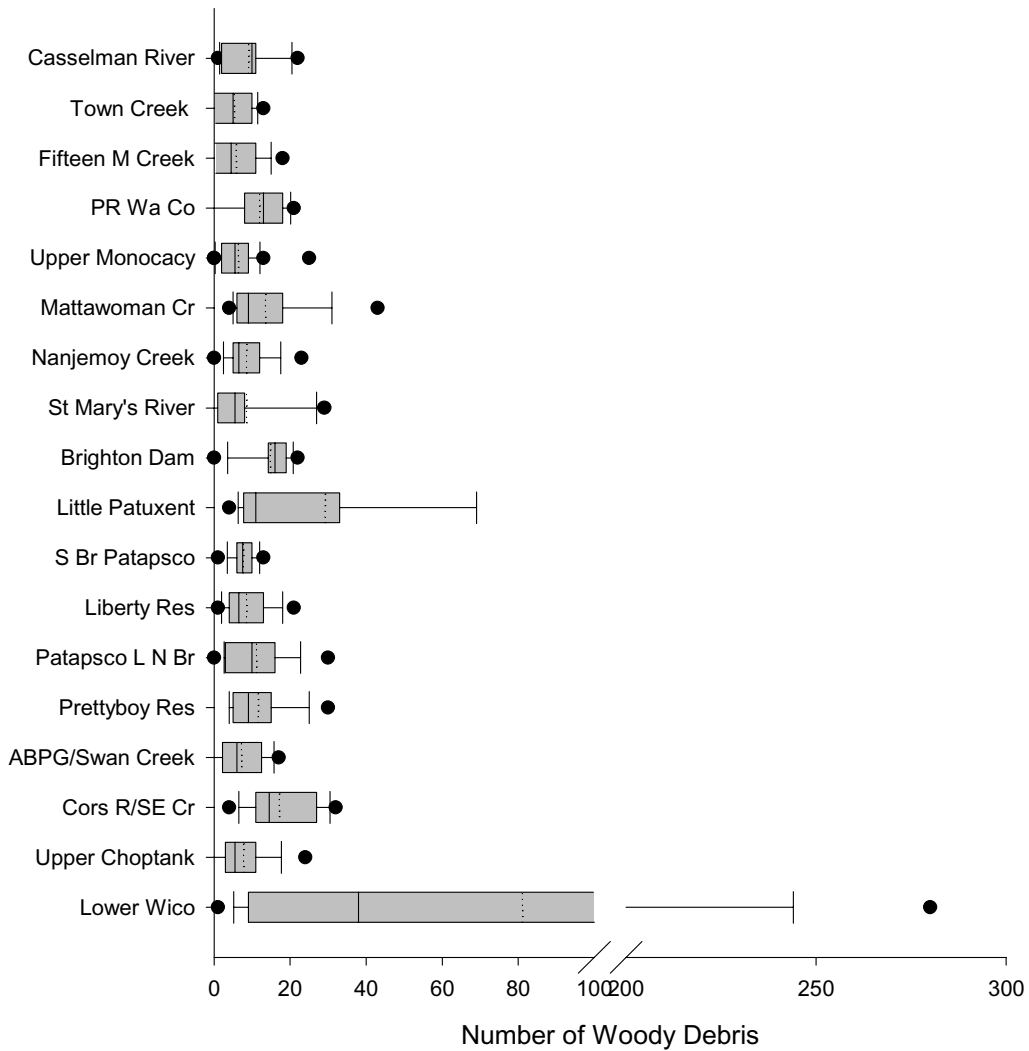


Figure 3-29. Distribution of the total number of woody debris (instream and dewatered) for the MBSS PSUs sampled in 2000

Number of Rootwads - Instream

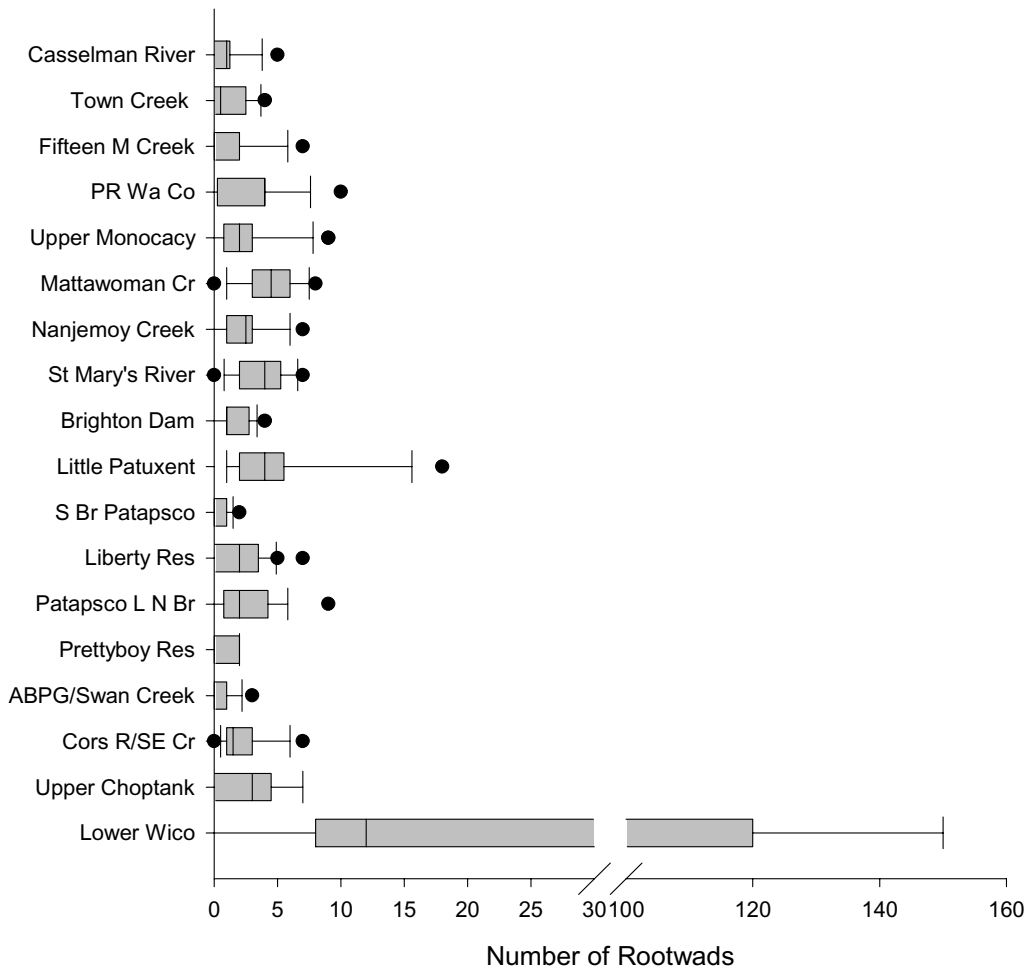


Figure 3-30. Distribution of the number of instream rootwads for the MBSS PSUs sampled in 2000

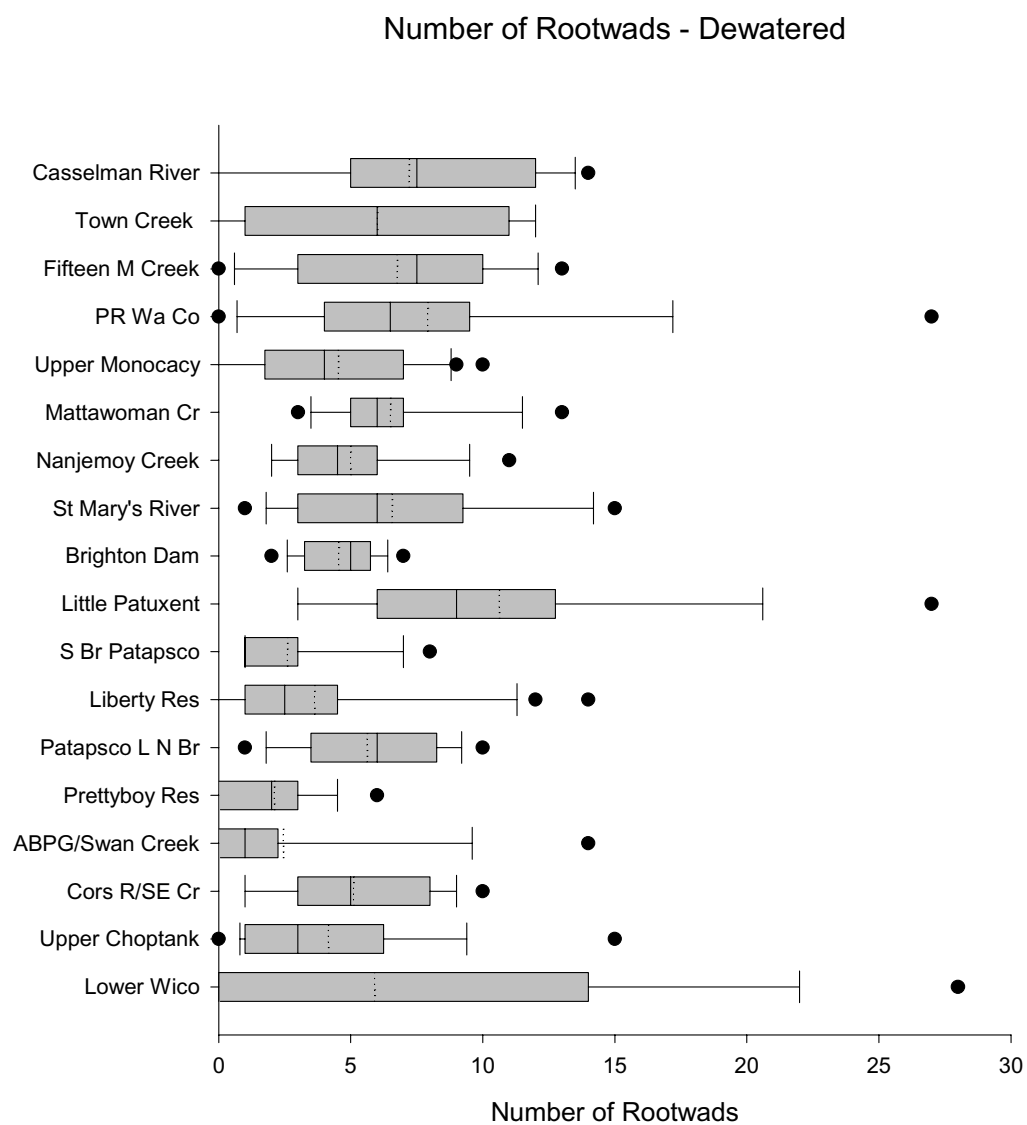


Figure 3-31. Distribution of the number of dewatered rootwads for the MBSS PSUs sampled in 2000

Number of Rootwads - Total

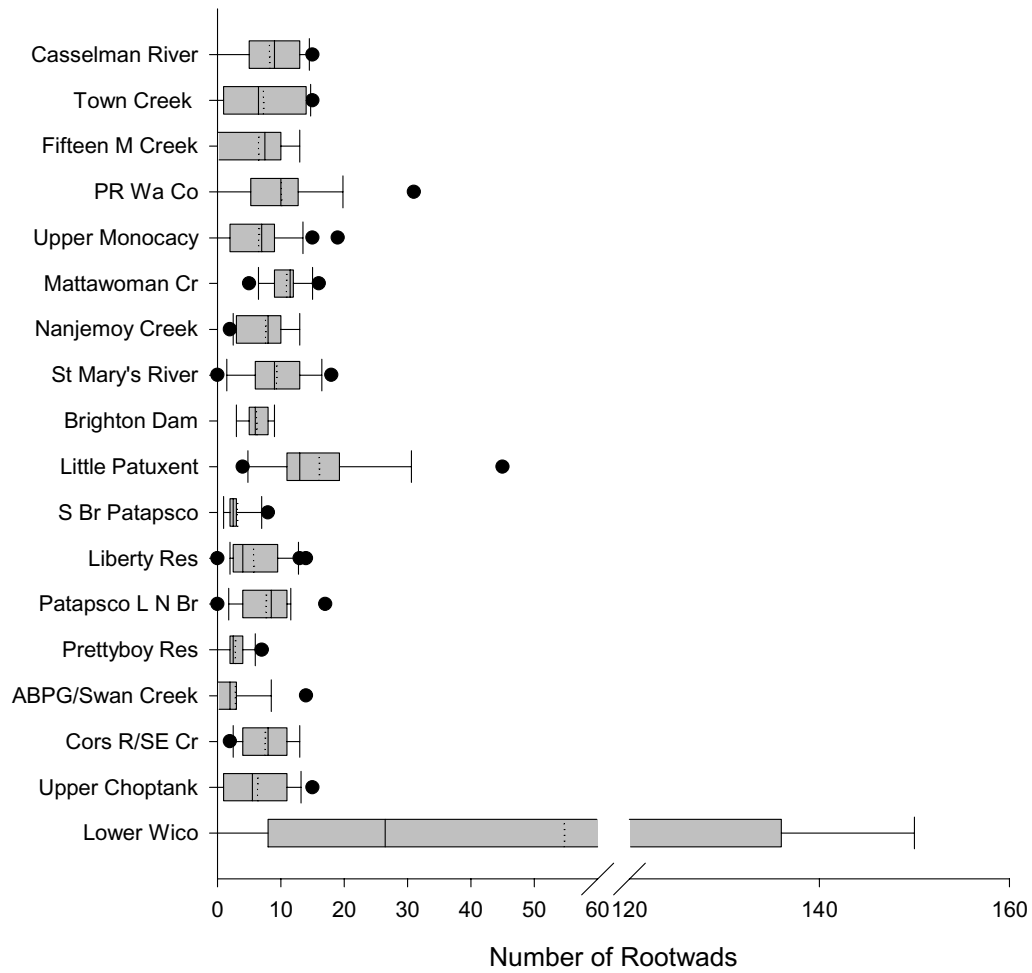


Figure 3-32. Distribution of the total number of rootwads (instream and dewatered) for the MBSS PSUs sampled in 2000

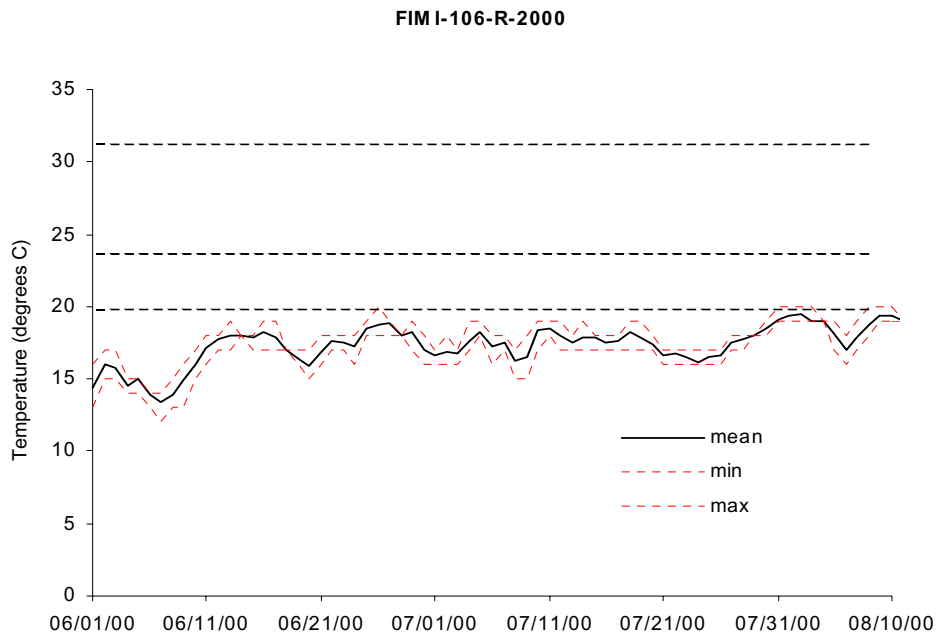


Figure 3-33. Mean, minimum, and maximum daily temperatures (degrees Celsius) for a coldwater stream sampled in the MBSS 2000, site FIMI-106-R-2000. Period of record was from June 1, 2000 to August 15, 2000.

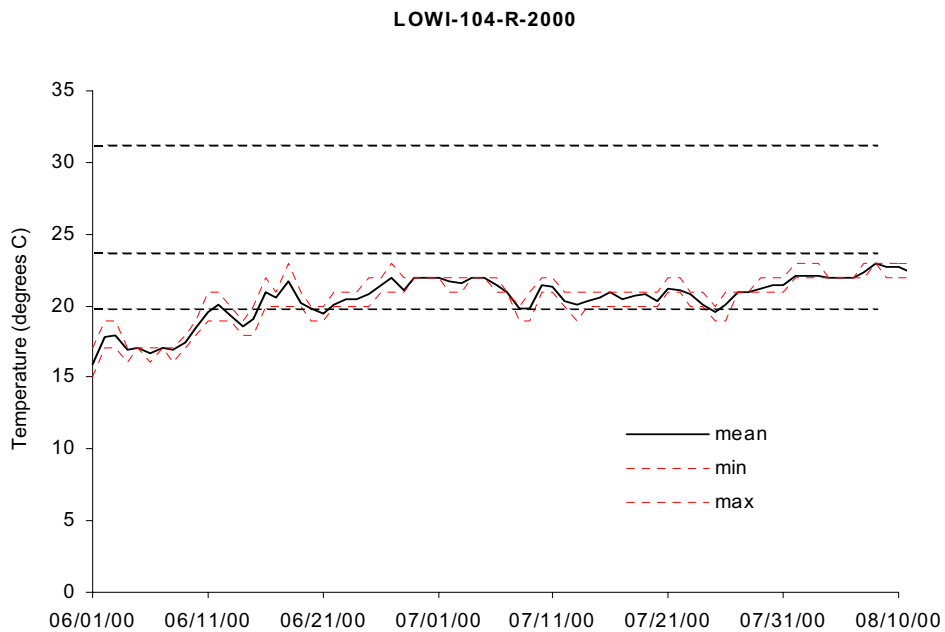


Figure 3-34. Mean, minimum, and maximum daily temperatures (degrees Celsius) for a warmwater stream sampled in the MBSS 2000, site LOWI-104-R-2000. Period of record was from June 1, 2000 to August 15, 2000.

loadings also requires data collected over time (i.e., taken over multiple years and seasons), the Survey's water chemistry results provide extensive spatial coverage and a useful picture of where nutrient levels are high.

In addition to various nitrogen and phosphorus measures, the Survey assesses dissolved oxygen (DO), turbidity, sulfate (as an indicator of AMD), chloride (an indicator of general anthropogenic disturbance), and dissolved organic carbon (DOC). Key results are summarized below. Where possible, results are compared with threshold levels likely to indicate human influence (Roth et al. 1999 and R. Morgan, personal communication, 2001). To illustrate the potential degree of human impact, many figures referenced below show data in relation to these thresholds, depicted in graphs by a vertical dotted line.

3.5.1 Nutrients

Total nitrogen (the sum of total dissolved and particulate nitrogen concentrations) tended to be highest in Central Maryland and the Eastern Shore, as well as Potomac River Washington County and Upper Monocacy PSUs in the west-central part of the state (Figures 3-35 and 3-36). In general, nitrate nitrogen (Figure 3-37) made up the largest fraction of total nitrogen. Nitrite nitrogen was higher in Central Maryland and the Eastern Shore than elsewhere in Maryland (Figure 3-38). As expected, ammonia, often associated with agricultural uses and animal wastes, was highest on the Eastern Shore (Figure 3-39). Results for total dissolved and particulate nitrogen are also shown (Figures 3-40 and 3-41). Appendix Tables B-26 to B-31 detail these results by PSU.

Nitrate nitrogen concentrations greater than 1 mg/l are commonly considered to indicate anthropogenic influence. This is several times higher than the concentration of 0.08 mg/l recently reported for streams in undisturbed watersheds (Clark et al. 2000). Mean nitrate nitrogen concentrations in 11 of 18 PSUs exceeded 1 mg/l. Estimates of the percentage of stream miles with nitrate nitrogen > 1 mg/l by PSU dramatically illustrate the extent of elevated nitrate levels, especially in Central Maryland (Figure 3-42, Appendix Table B-32). In several PSUs, nearly 100% of stream miles have high nitrate nitrogen concentrations.

Total phosphorus (the sum of total dissolved and particulate phosphorus concentrations) tended to be substantially higher on the Eastern Shore, lower in Western Maryland, and moderate in the central part of the state (Figure 3-43, 3-44). Results for orthophosphate, total dissolved, and total particulate phosphorus are also shown (Figures 3-45 to 3-47). Appendix Tables B-33 to B-36 detail these results by PSU.

3.5.2 Other Water Quality Parameters

Dissolved oxygen concentrations at most locations were greater than 5 mg/l, the COMAR standard and a level generally considered healthy for aquatic life (Figure 3-48, Appendix Table B-37). The only PSU with a mean DO < 5 mg/l was Lower Wicomico PSU, where swampy blackwater streams and sluggish waters are naturally lower in DO, but also particularly susceptible to BOD loading from anthropogenic sources. Individual sites with low DO should be examined for similar, natural causes before concluding that impacts exist. Estimates of the percentage of stream miles with low DO are given in Figure 3-49 (Appendix Table B-38). Seasonal monitoring of streams suspected to have low DO problems and examination of watershed factors would help to diagnose situations where the problem is persistent and can be linked to anthropogenic causes.

As expected, turbidity was generally low (Figure 3-50, Appendix Table B-39). However, a more complete characterization of turbidity in a given stream would require sampling during storm events.

Sulfate values were not generally high (Figure 3-51, Appendix Table B-40). Several outliers were observed in Potomac River Washington County PSU.

Chloride (Figure 3-52, Appendix Table B-41) tended to be highest in urban areas, and also at several sites in Casselman River watershed that were near roadways and probably received substantial amounts of road salt.

As expected, mean dissolved organic carbon (DOC) (Figure 3-53, Appendix Table B-42) and particulate carbon (Figure 3-54, Appendix Table B-43) were highest in Coastal Plain basins, especially on the Eastern Shore.

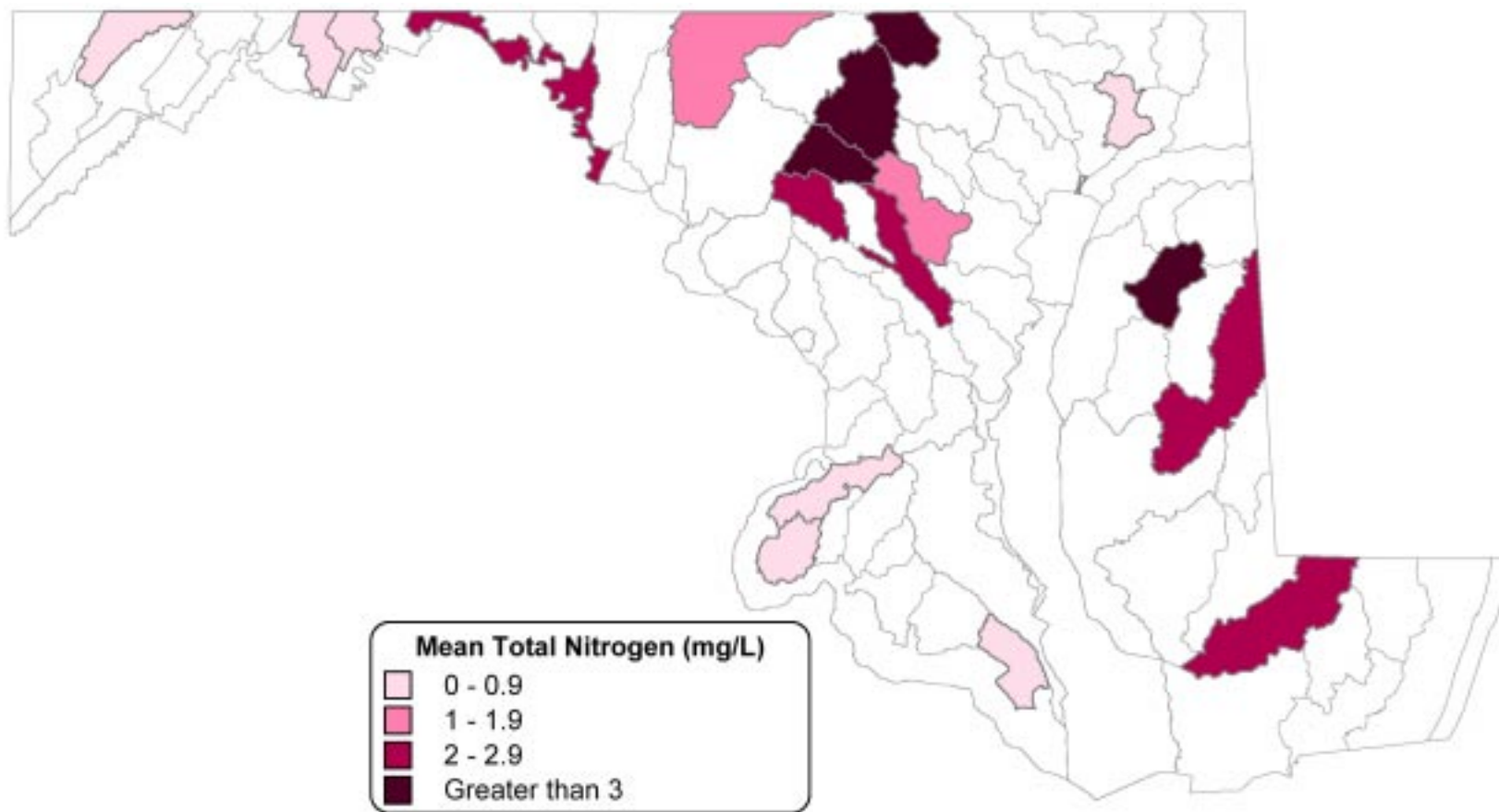


Figure 3-35. Distribution of total nitrogen values (mg/L) for the MBSS PSUs sampled in 2000

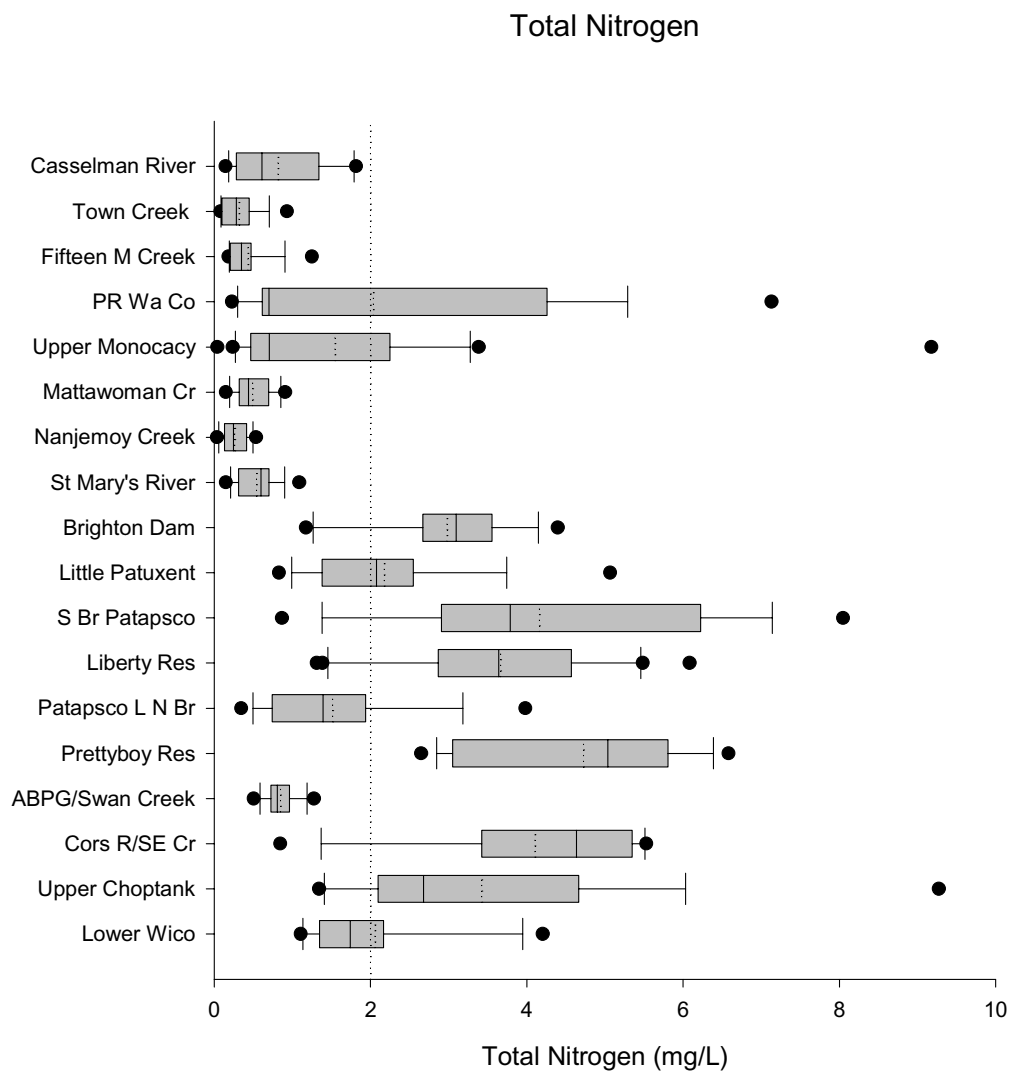


Figure 3-36. Distribution of total nitrogen values (mg/L) for the MBSS PSUs sampled in 2000. Dotted line represents threshold above which anthropogenic impacts are likely.

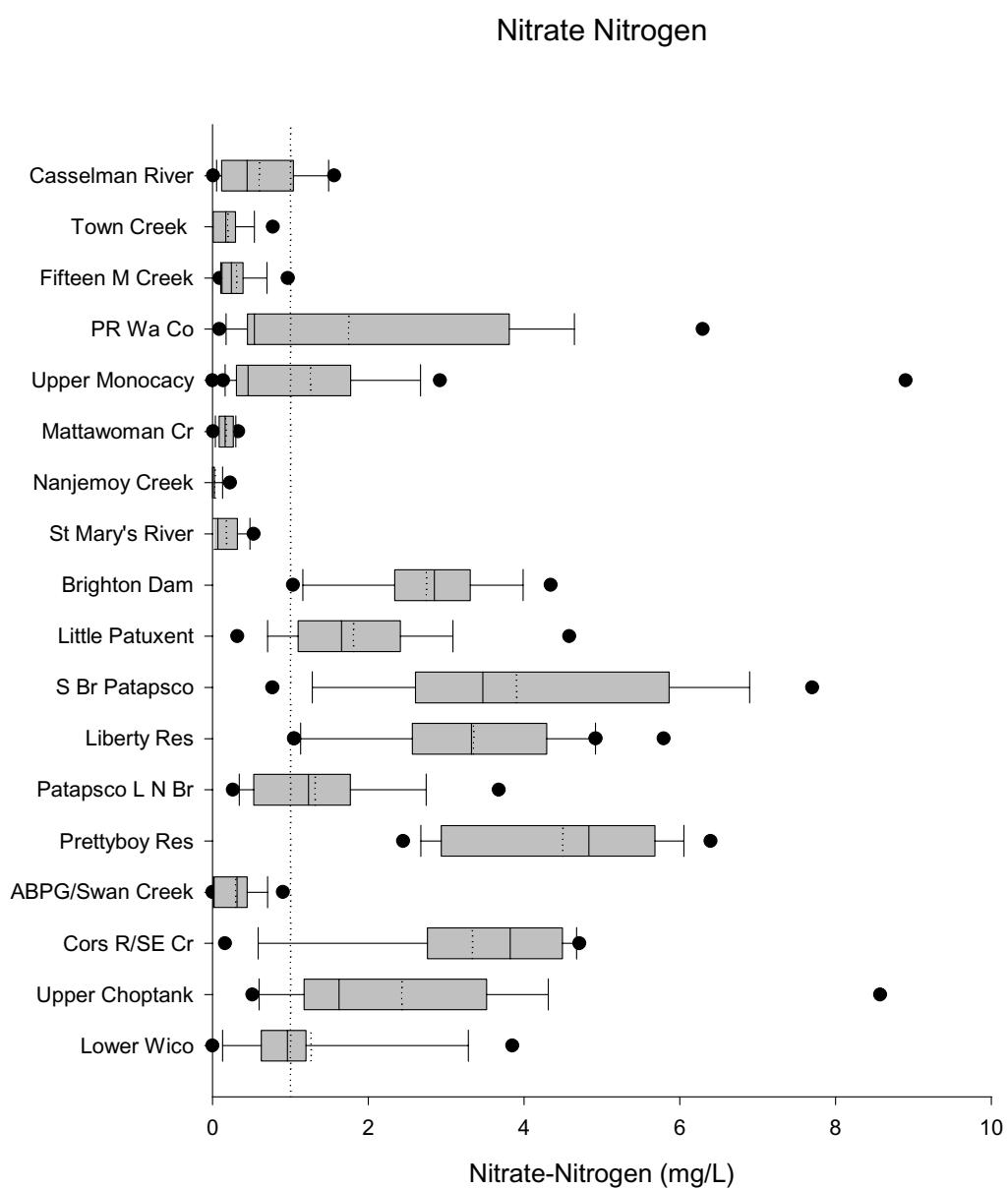


Figure 3-37. Distribution of nitrate-nitrogen values (mg/L) for the MBSS PSUs sampled in 2000. Dotted line represents threshold above which anthropogenic impacts are likely.

Nitrite Nitrogen

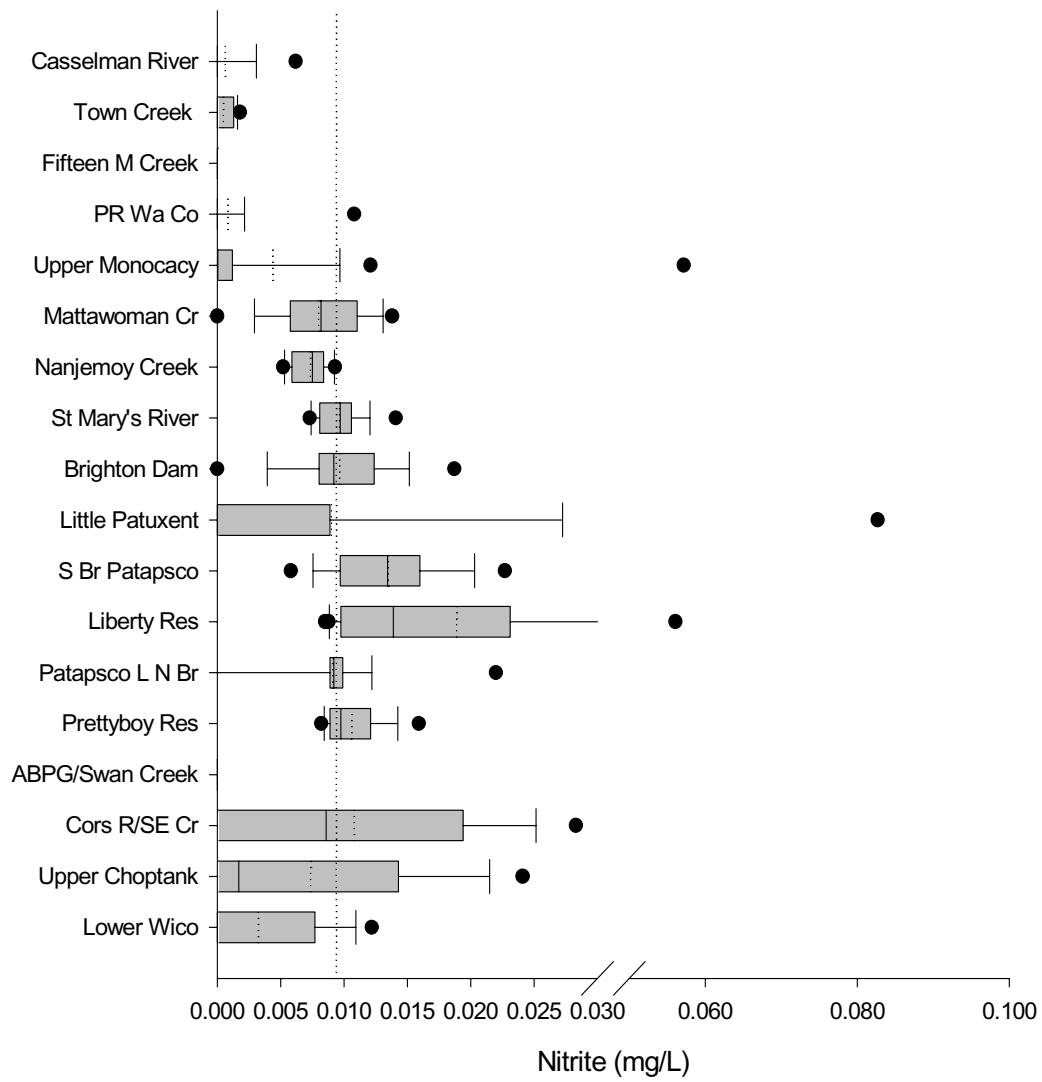


Figure 3-38. Distribution of nitrite-nitrogen values (mg/L) for the MBSS PSUs sampled in 2000. Dotted line represents threshold above which anthropogenic impacts are likely.

Ammonia

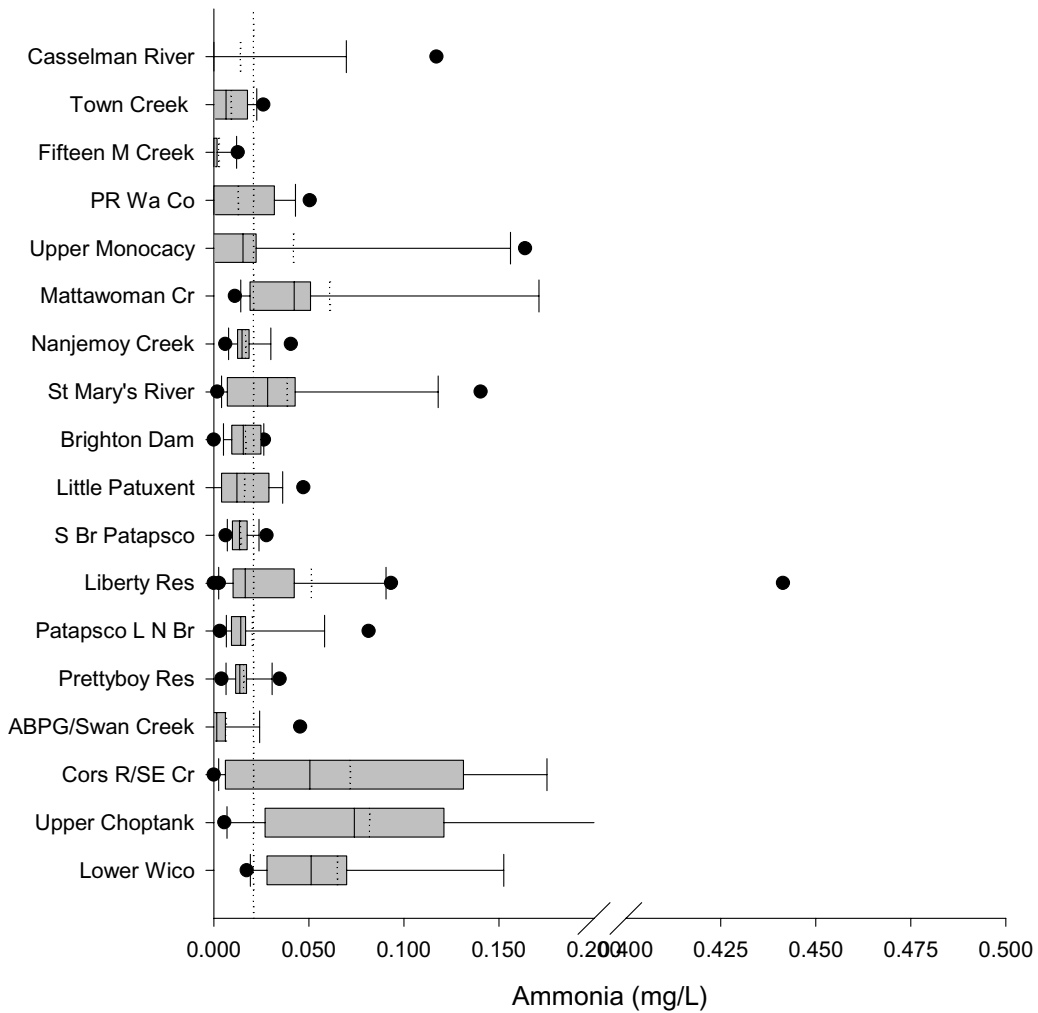


Figure 3-39. Distribution of ammonia values (mg/L) for the MBSS PSUs sampled in 2000. Dotted line represents threshold above which anthropogenic impacts are likely.

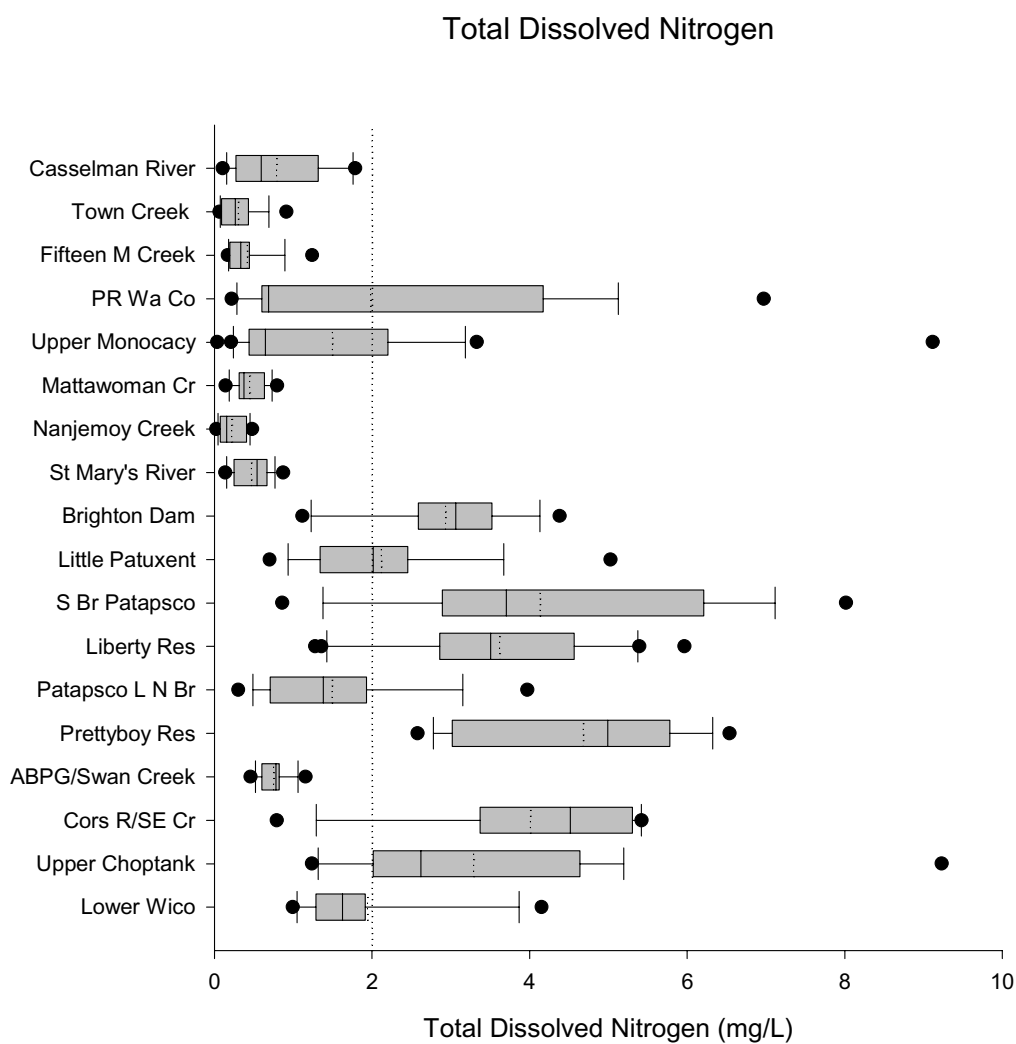


Figure 3-40. Distribution of total dissolved nitrogen values (mg/L) for the MBSS PSUs sampled in 2000. Dotted line represents threshold above which anthropogenic impacts are likely.

Particulate Nitrogen

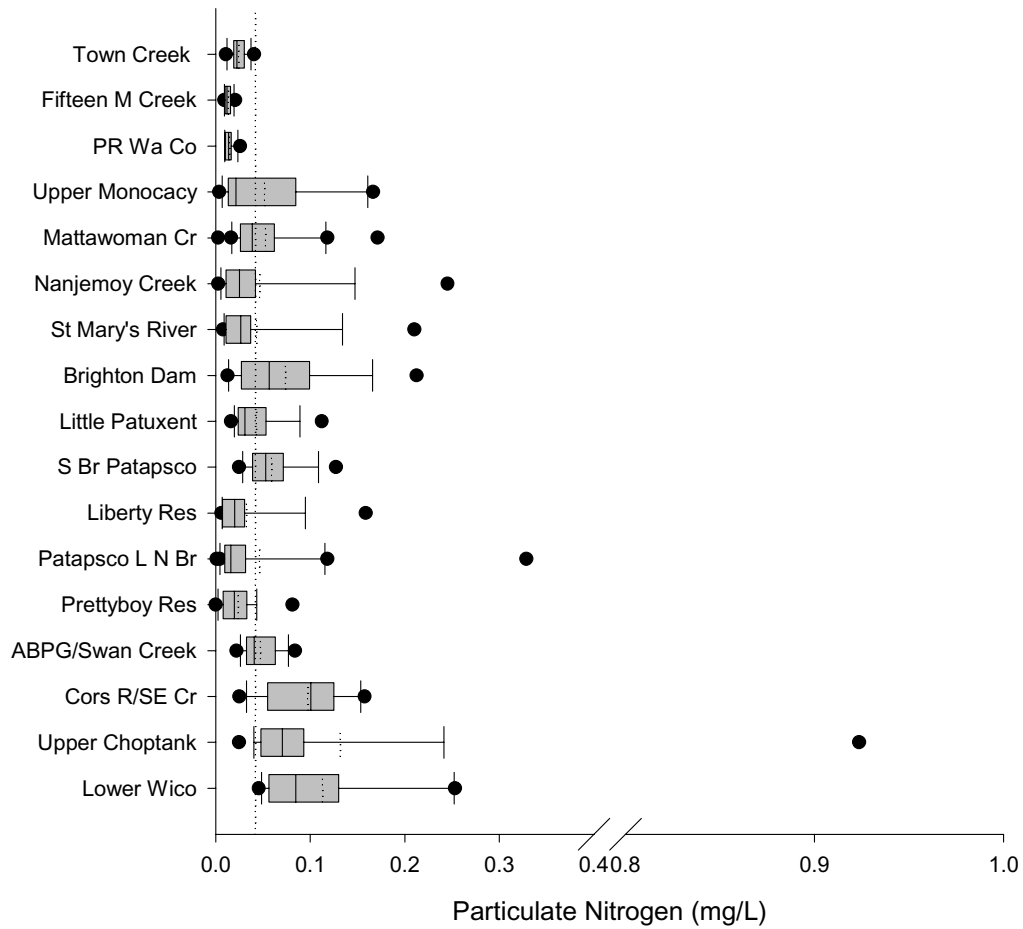


Figure 3-41. Distribution of particulate nitrogen values (mg/L) for the MBSS PSUs sampled in 2000. Dotted line represents threshold above which anthropogenic impacts are likely.

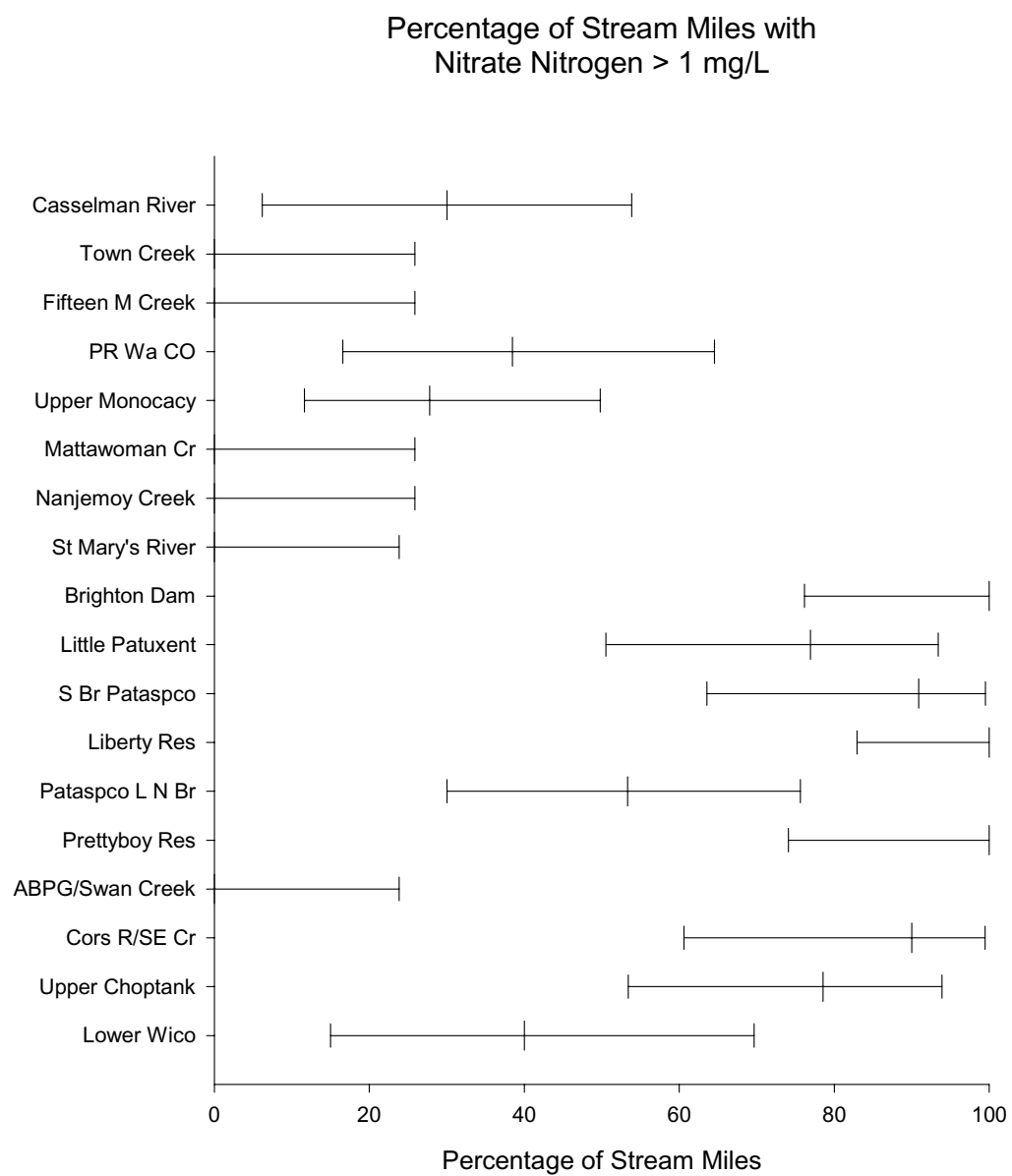


Figure 3-42. Percentage of stream miles with nitrate-nitrogen greater than 1.0 mg/L for the MBSS PSUs sampled in 2000

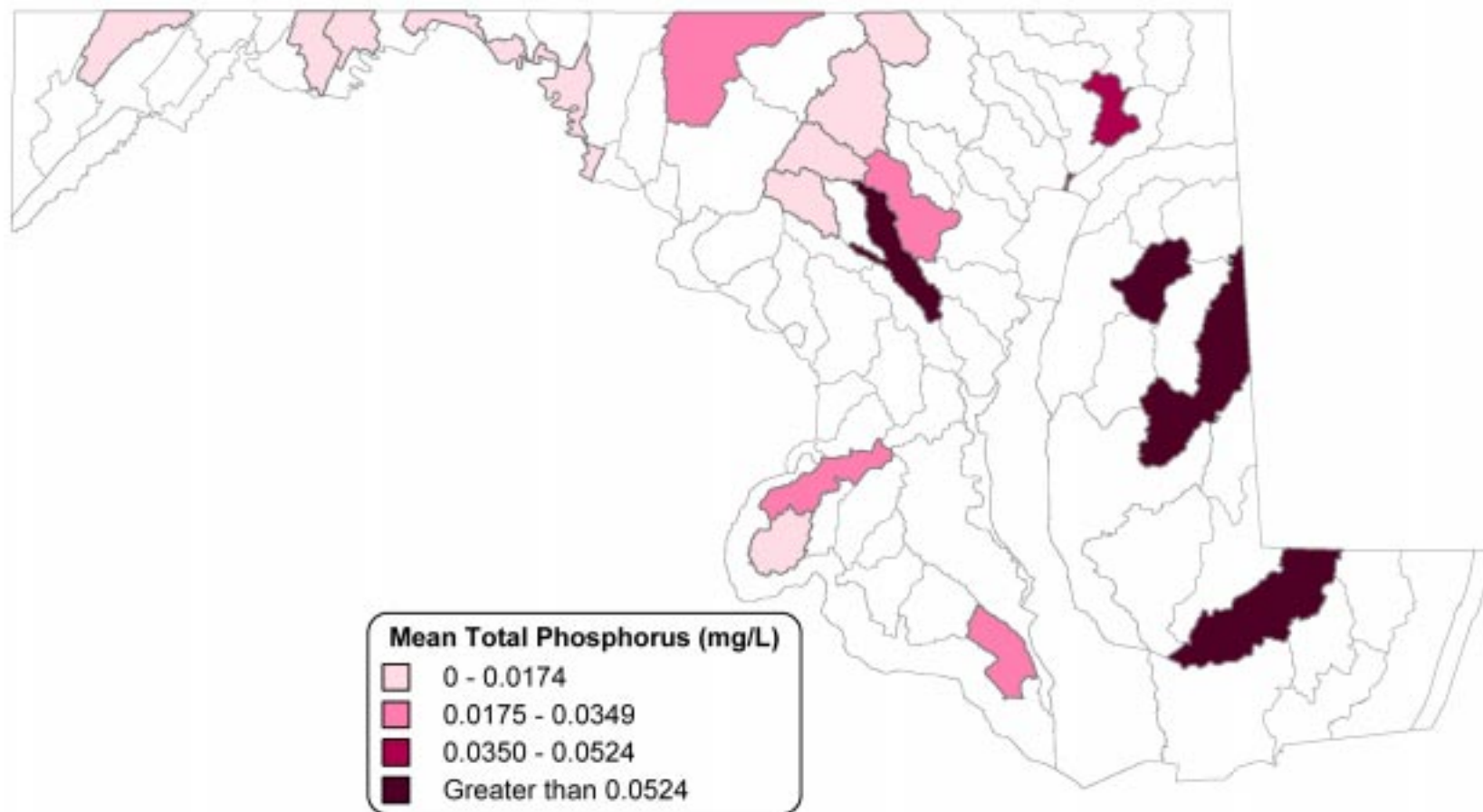


Figure 3-43. Distribution of total phosphorus values (mg/L) for the MBSS PSUs sampled in 2000

Total Phosphorus

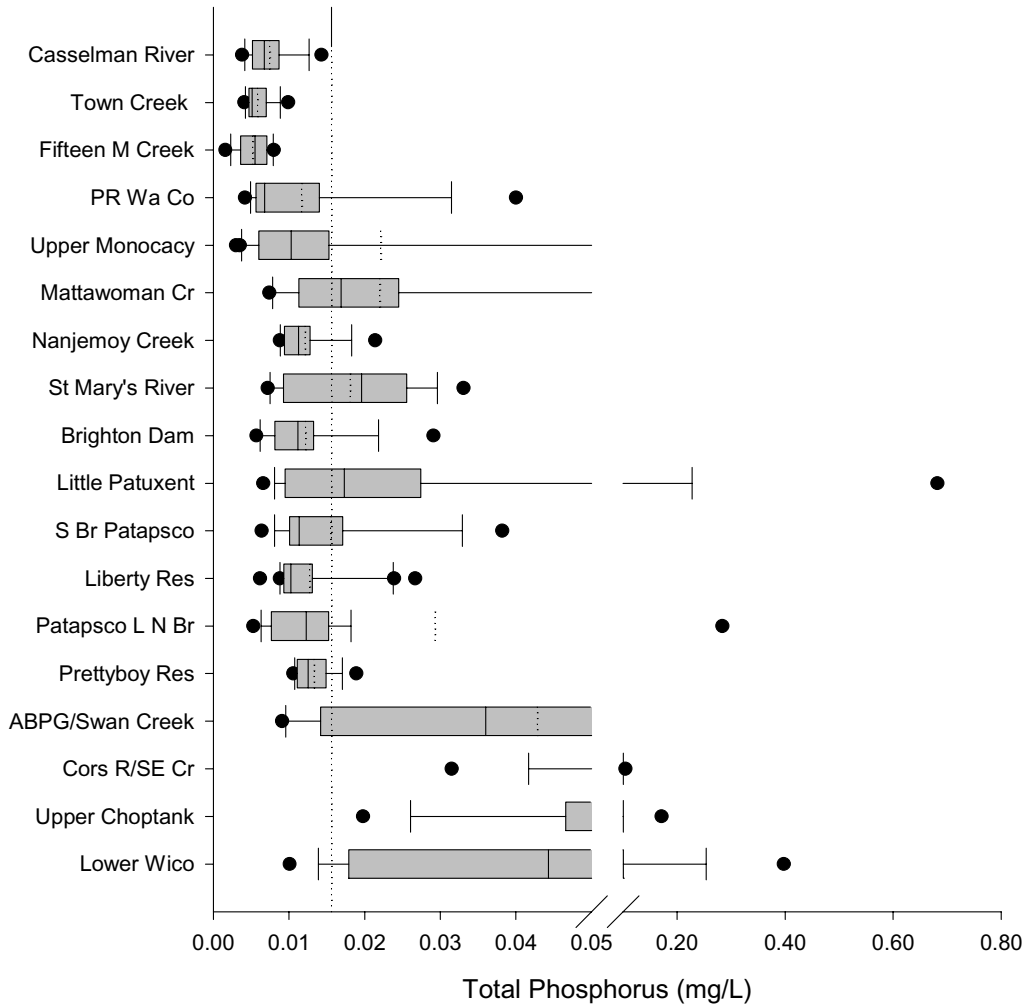


Figure 3-44. Distribution of total phosphorus values (mg/L) for the MBSS PSUs sampled in 2000. Dotted line represents threshold above which anthropogenic impacts are likely.

Orthophosphate

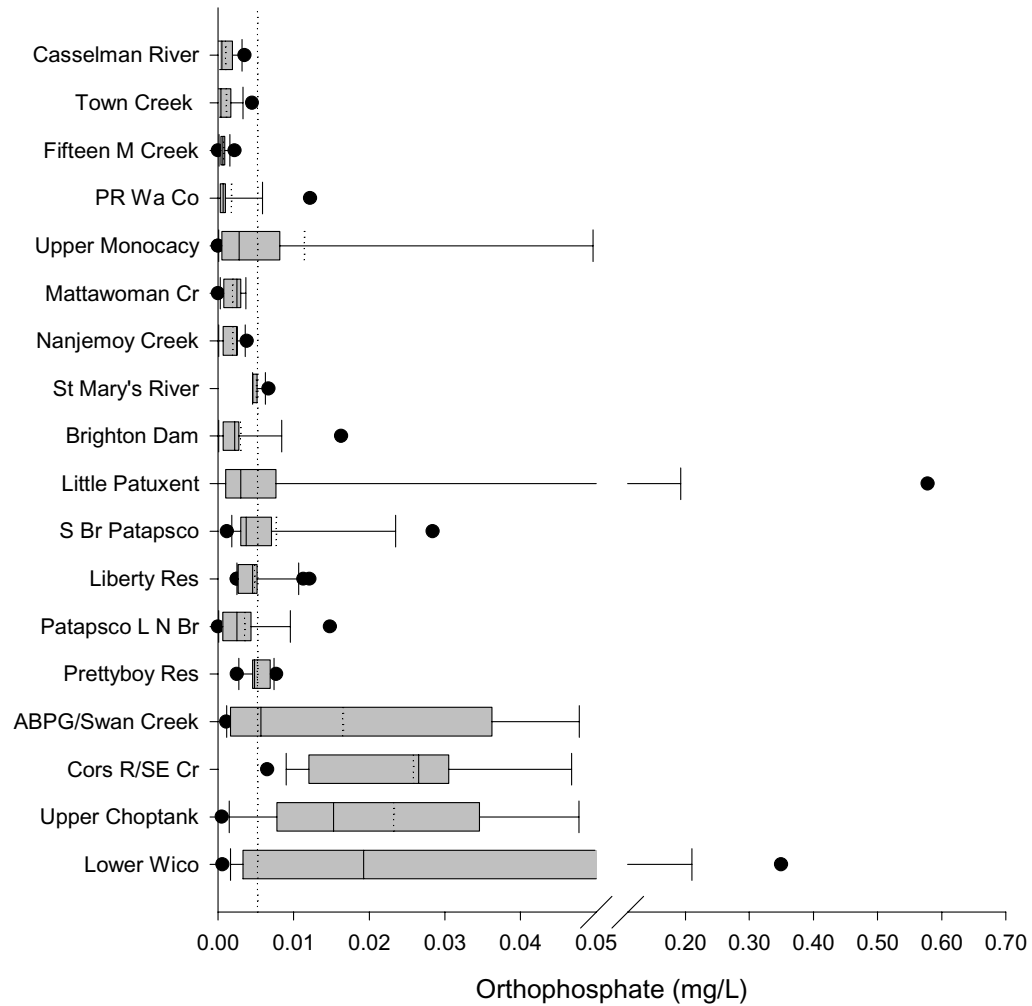


Figure 3-45. Distribution of orthophosphate values (mg/L) for the MBSS PSUs sampled in 2000. Dotted line represents threshold above which anthropogenic impacts are likely.

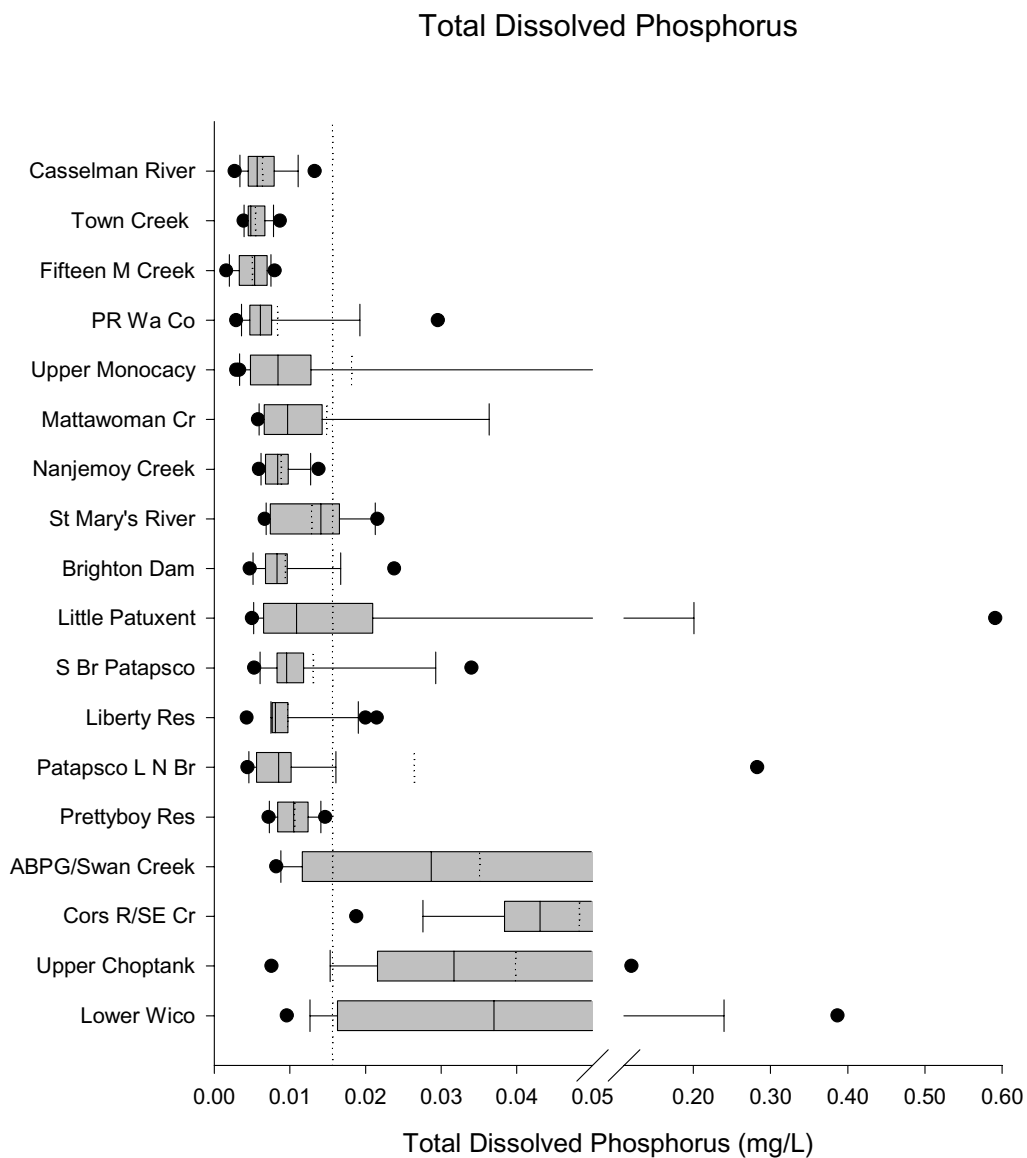


Figure 3-46. Distribution of total dissolved phosphorus values (mg/L) for the MBSS PSUs sampled in 2000. Dotted line represents threshold above which anthropogenic impacts are likely.

Particulate Phosphorus

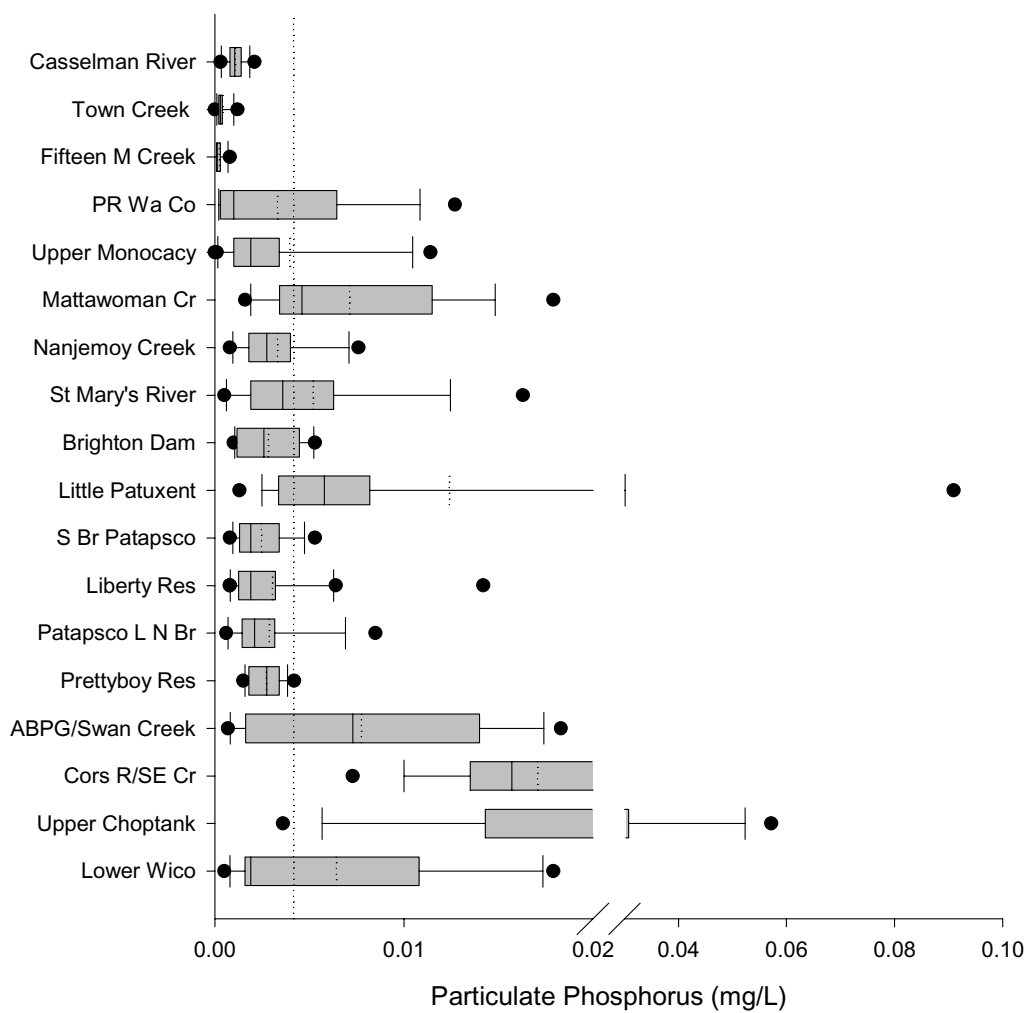


Figure 3-47. Distribution of particulate phosphorus values (mg/L) for the MBSS PSUs sampled in 2000. Dotted line represents threshold above which anthropogenic impacts are likely.

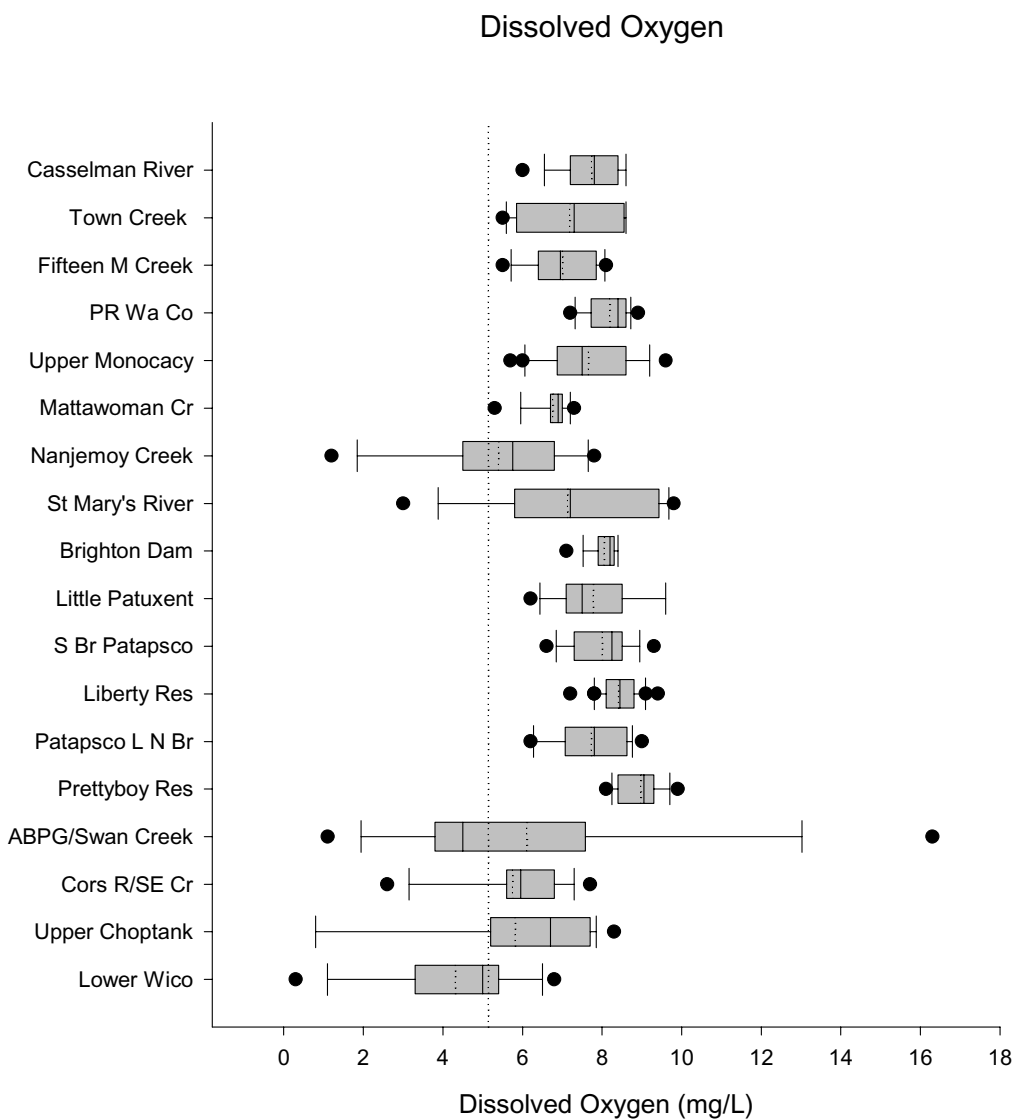


Figure 3-48. Distribution of dissolved oxygen concentrations (mg/L) for the MBSS PSUs sampled in 2000. Dotted line represents threshold below which anthropogenic impacts are likely.

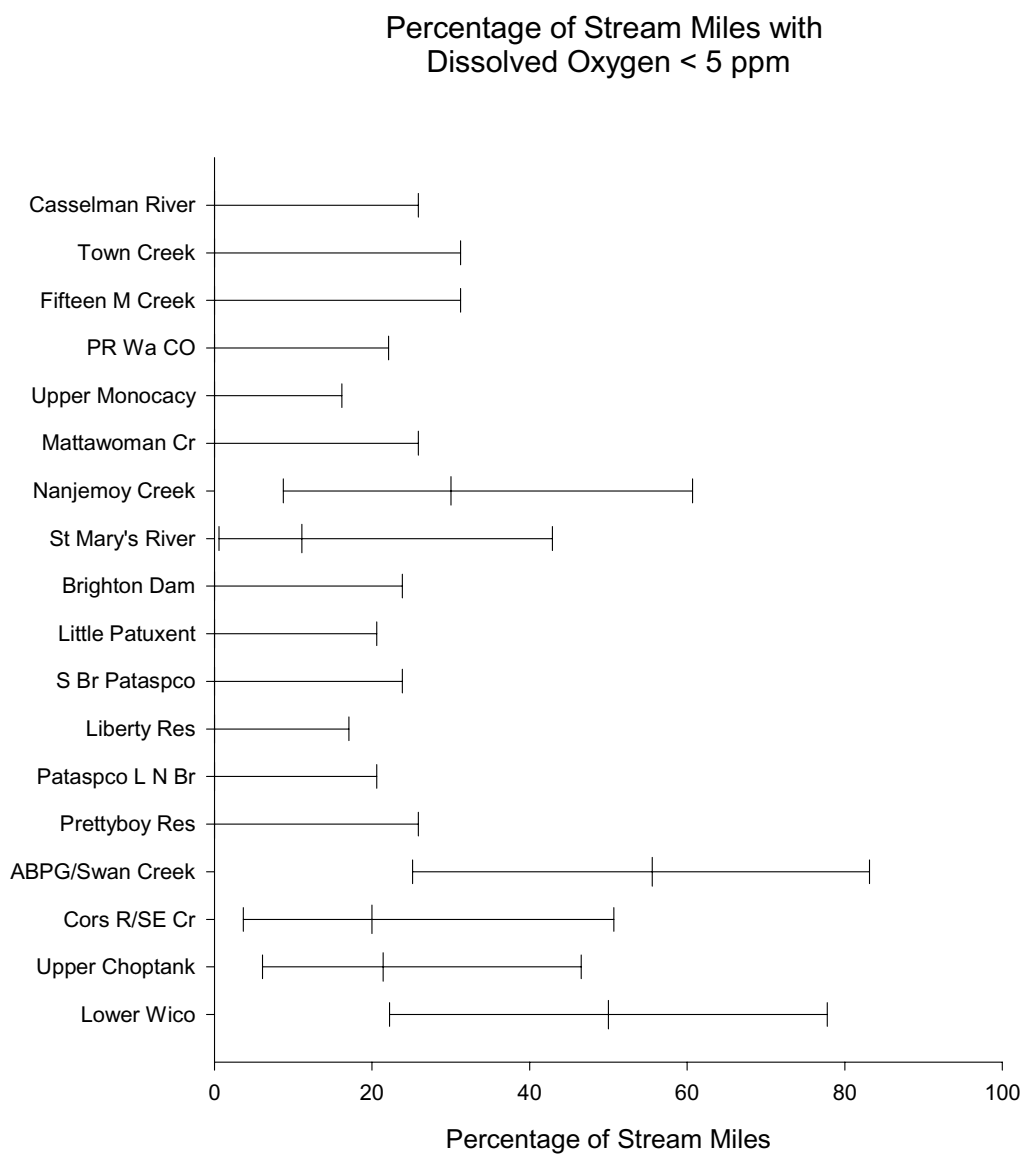


Figure 3-49. Percentage of stream miles with dissolved oxygen concentrations < 5.0 mg/L for the MBSS PSUs sampled in 2000

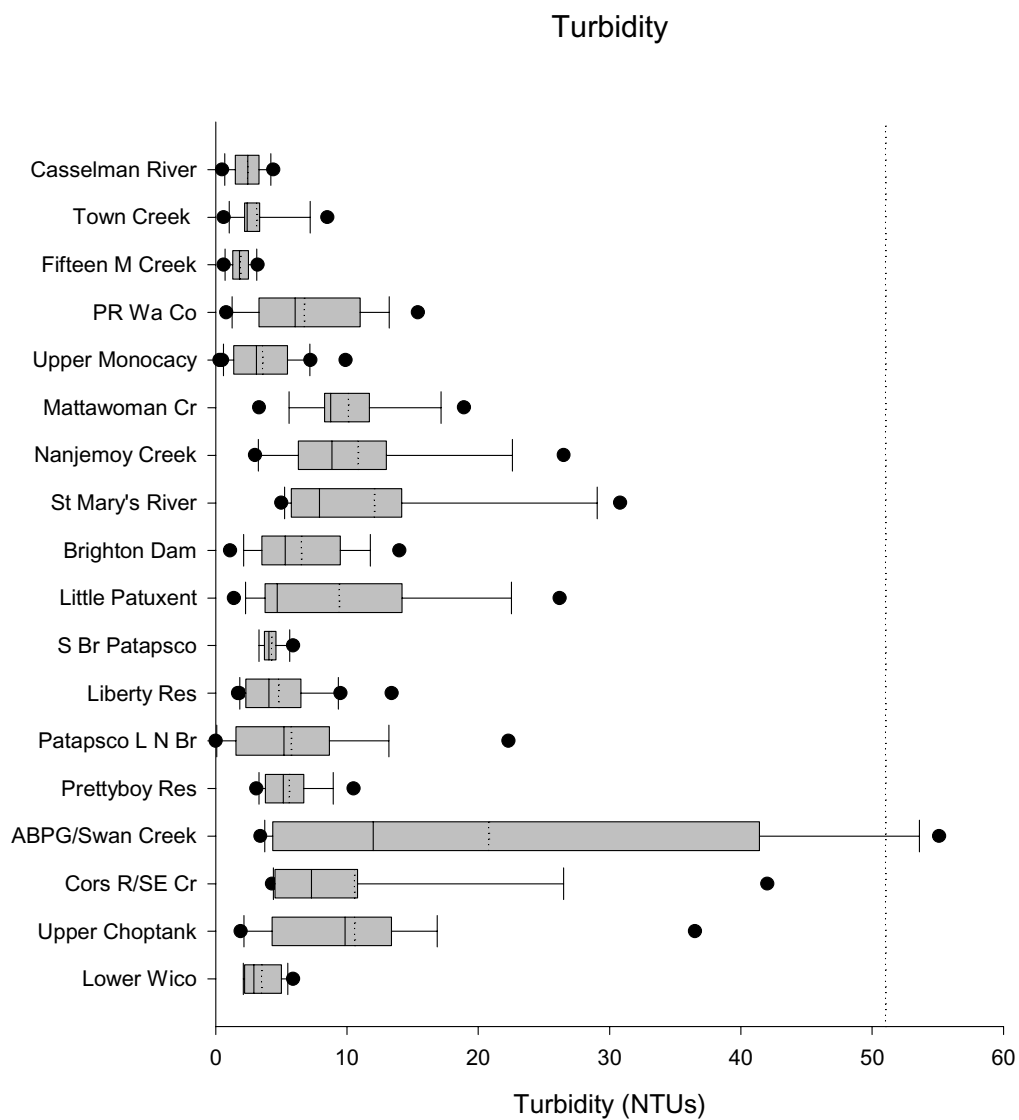


Figure 3-50. Distribution of turbidity values (NTUs) for the MBSS PSUs sampled in 2000. Dotted line represents threshold above which anthropogenic impacts are likely.

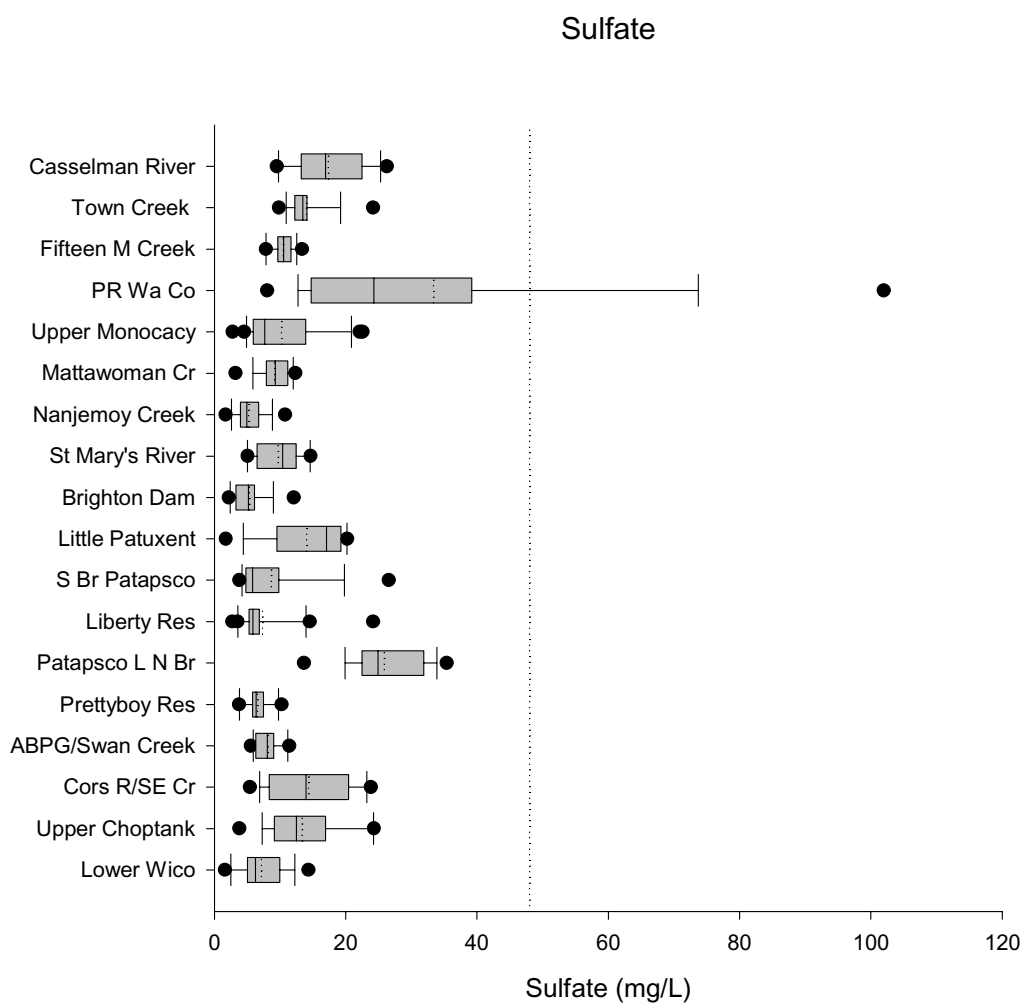


Figure 3-51. Distribution of sulfate values (mg/L) for the MBSS PSUs sampled in 2000. Dotted line represents threshold above which anthropogenic impacts are likely.

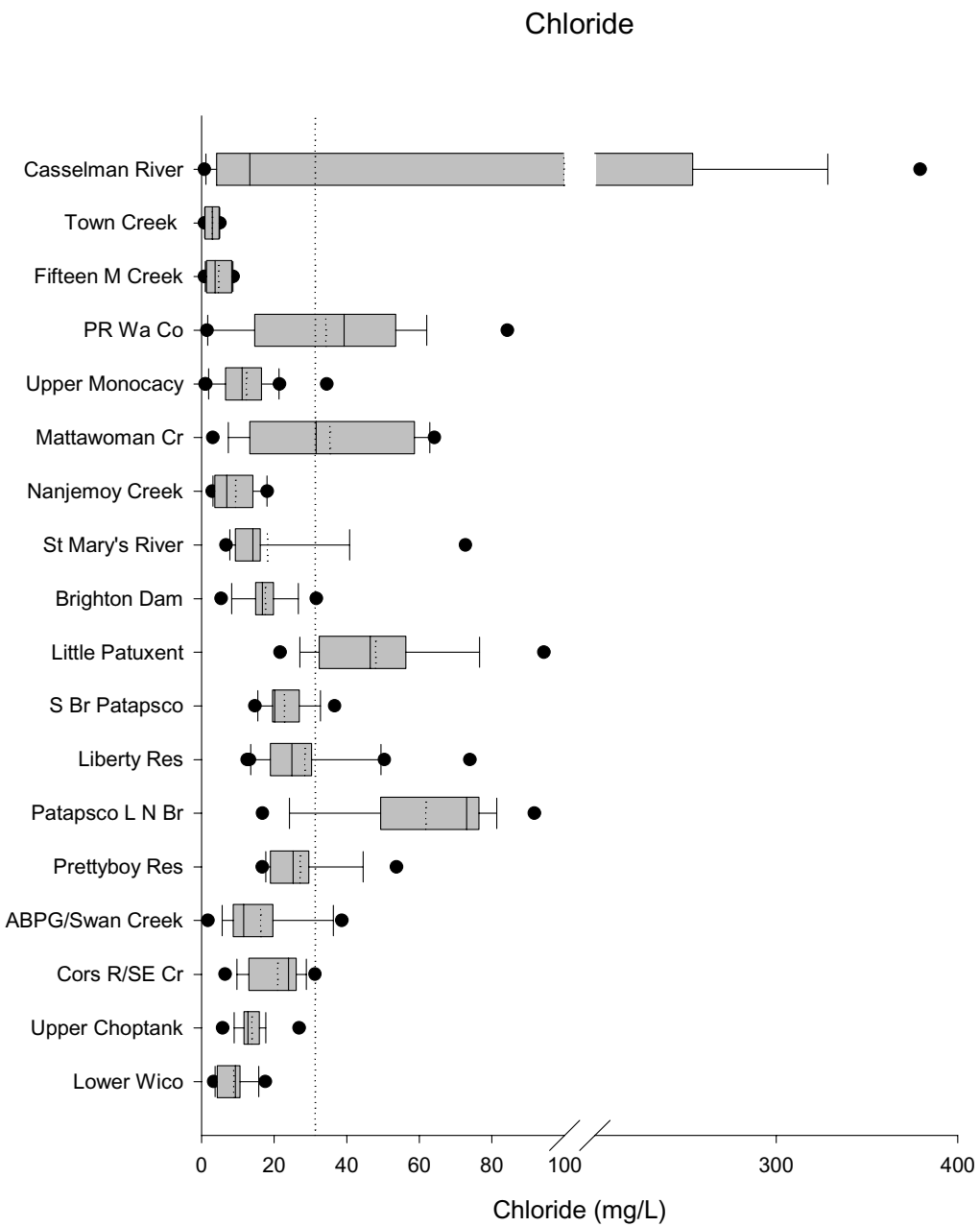


Figure 3-52. Distribution of chloride values (mg/L) for the MBSS PSUs sampled in 2000. Dotted line represents threshold above which anthropogenic impacts are likely.

Dissolved Organic Carbon

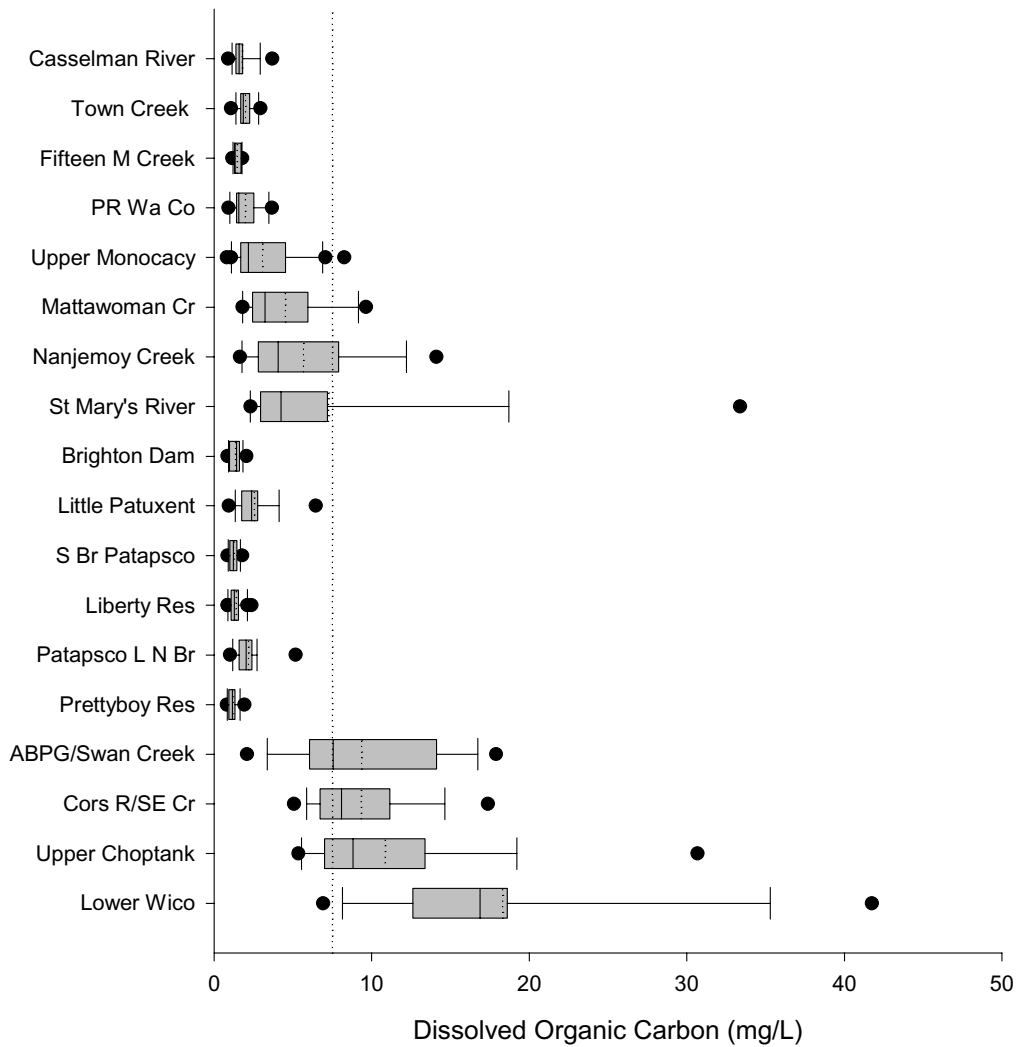


Figure 3-53. Distribution of dissolved organic carbon values (mg/L) for the MBSS PSUs sampled in 2000. Dotted line represents threshold above which blackwater stream conditions or (less commonly) anthropogenic impacts are likely.

Particulate Carbon

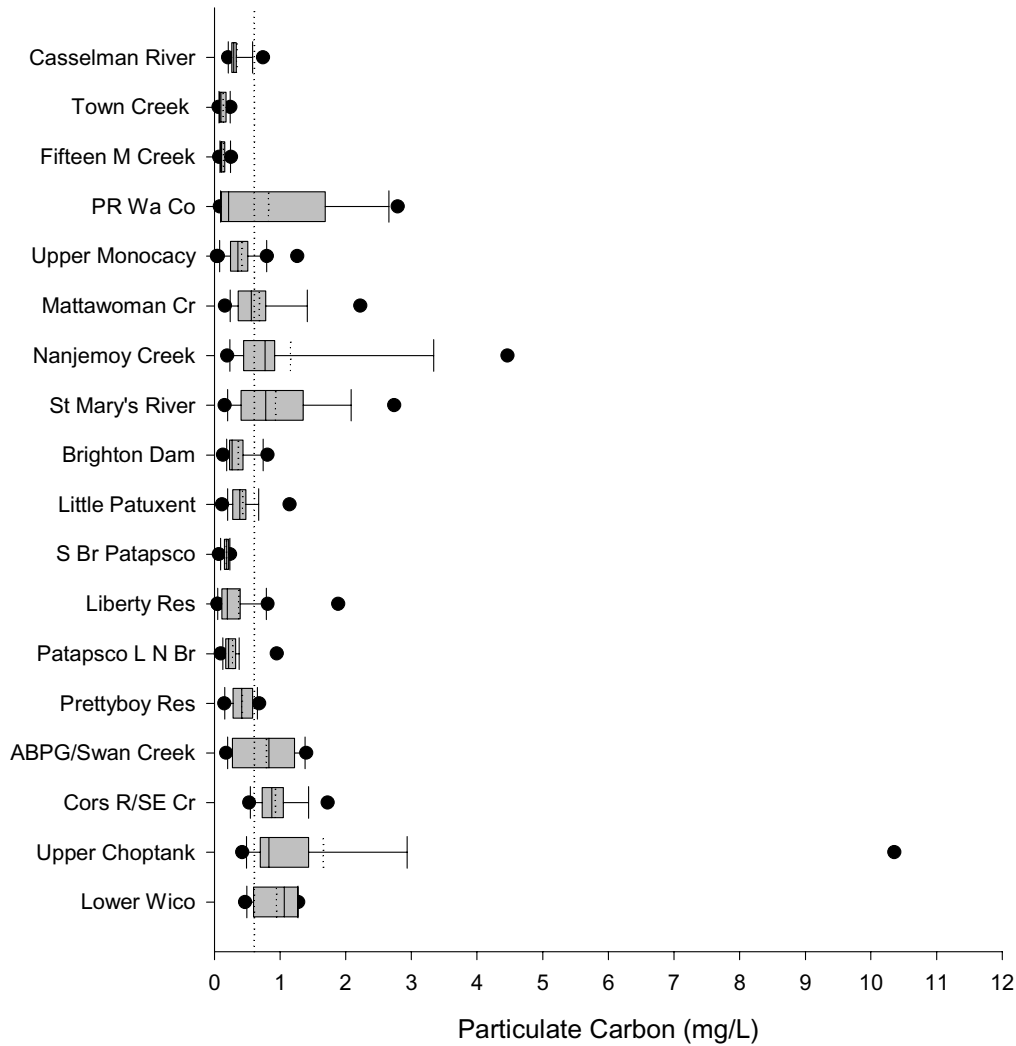


Figure 3-54. Distribution of particulate carbon values (mg/L) for the MBSS PSUs sampled in 2000. Dotted line represents threshold above which blackwater stream conditions or (less commonly) anthropogenic impacts are likely.

4 SUMMARY OF SAMPLING RESULTS FOR INDIVIDUAL WATERSHEDS

Since the primary focus of the 2000-2004 Round Two of the MBSS (or Survey) is on smaller watersheds than in Round One, more attention has been paid to examining sampling results and potential stressors at individual sites. Although a complete assessment of watershed-wide conditions would require more information, data collected at specific MBSS sites provide a starting point for understanding and describing the condition of the watershed.

This chapter includes a summary for each of the 18 primary sampling units or PSUs (single or combined 8-digit watersheds) randomly sampled in the 2000 MBSS, as well as a summary for the Lower Monocacy River watershed, which was sampled specifically to support application of biocriteria by the State (see Chapter 7). Each summary begins with a map of the PSU, which shows 8-digit watershed and 12-digit subwatershed boundaries, county boundaries, major towns and roads, and selected public lands. This information provides a geographical context for the sites sampled by the Survey. These maps also include the locations of the MBSS sample points, with symbols indicating the fish and benthic IBI scores (a key to this map is included in Table 4-1). The same page of each PSU summary lists the total land area and the total number of sampleable stream miles (by individual 8-digit watershed).

Each PSU summary includes a land cover map derived from the Multi-Resolution Land Characteristics (MRLC) Version 98-07 (based on remote sensing data from the early 1990s). A key to this map is provided in Table 4-1. A bar chart for each 8-digit watershed shows the percentage of land in each land cover class.

Following the maps are tables containing a variety of information on the sites sampled in each PSU. The first table contains locational information for each site, including the stream name, 12-digit subwatershed code, 8-digit watershed

name, basin, county, stream order, and upstream catchment area. The second table is one containing information pertinent to the indicators calculated for each site (fish, benthic, and physical habitat). The third table gives the percentage of the upstream catchment area in urban, agricultural, forested, or other (water, barren, and/or wetlands) land cover for each site. Below these tables is a short summary of the conditions in the PSU, including pertinent comments taken from field data sheets. A water chemistry table is provided, including values for the analytes measured at each site (see Chapter 2). Two tables providing information on physical habitat quality and modifications are also included in each PSU report. Throughout these tables, values that exceed or fall short of established thresholds (denoting likely degraded condition or potential stress) are shaded. A key to the variables in all of these tables is given in Table 4-1.

Finally, each PSU report includes a list of organisms found throughout the PSU. Included on this page are species lists for fish, exotic plants, and herpetofauna, as well as a taxa list for benthic macroinvertebrates. Taken together, these data can be used to begin to assess stream quality in each PSU. For example, in the Little Patuxent River PSU, indicator scores at most sites are moderate to low, indicating that most streams sampled in the PSU are disturbed. Maps and data also indicate that urban and suburban land uses are widespread and that many sampled sites had elevated chloride, nitrogen, and phosphorous levels, as well as siltation and erosion problems. In this PSU, development is probably a significant stressor on stream water quality, contributing to elevated pollution and physical habitat degradation, which in turn result in low indicator scores. A similar assessment can be done for each PSU, providing a preliminary identification of the specific stressors of concern in the PSU.

Table 4-1. Key to PSU reports for PSUs sampled in the 2000 MBSS



Table 4-1. (Continued)

Colors used in Landuse Maps










 Open Water	 Deciduous Forest
 Low Intensity Residential	 Evergreen Forest
 High Intensity Residential	 Mixed Forest
 Commercial/Industrial	 Pasture/Hay
 Bare Rock	 Row Crops
 Mines	 Other Grasses
 Transitional	 Woody Wetlands
	 Emergent Wetlands

Table 4-1. (Continued)

Guide to Variables in PSU Reports

Site Information

Site: MBSS site name, in the following format: Watershed Abbreviation - Segment Number - Site Type - Year Sampled (Site Type R = Randomly selected site)

Stream Name: Name of stream sampled

12-digit Watershed Code: Maryland 12-digit watershed code

8-digit Watershed: Maryland 8-digit watershed name

Basin: Maryland drainage basin name

County: Maryland county

Date Sampled Spring: Date site was sampled in the spring

Date Sampled Summer: Date site was sampled in the summer (NS = Not Sampled)

Order: Strahler stream order

Catchment Area: Area of upstream catchment in acres

Indicator Information

FIBI: Fish Index of Biotic Integrity, scored on the following scale:

1.0 - 1.9 Very Poor

2.0 - 2.9 Poor

3.0 - 3.9 Fair

4.0 - 5.0 Good

NS Not Sampled

NR Not Rated (site is not rated if catchment area is < 300 acres, or if the site is a brook trout or blackwater stream and would have received a score of less than 3.0)

Site is shaded if IBI score is < 3.0

BIBI: Benthic Index of Biotic Integrity, scored on the following scale:

1.0 - 1.9 Very Poor

2.0 - 2.9 Poor

3.0 - 3.9 Fair

4.0 - 5.0 Good

NS Not Sampled

NR Not Rated

Site is shaded if IBI score is < 3.0

Table 4-1. (Continued)

PHI: Physical Habitat Index, scored on the following scale:

0 - 11.9 Very Poor

12 - 41.9 Poor

42 - 71.9 Fair

72 - 100 Good

NS Not Sampled

NR Not Rated

Site is shaded if PHI score is < 42

Brook Trout Present: 0 = Not present in sample segment, 1 = Present in sample segment, NS = Not Sampled

Black Water Stream: 0 = Not a blackwater stream, 1 = Blackwater stream (pH < 5 or ANC < 200 μ eq/L and Dissolved Organic Carbon \geq 8 mg/L), NS = Not Sampled

Catchment Land Use Information

Percent Urban: Percentage of urban land use in catchment upstream of site. Site is shaded if value is \geq 25%.

Percent Agriculture: Percentage of agricultural land use in catchment upstream of site. Site is shaded if values is \geq 75%.

Percent Forest: Percentage of forested land use in catchment upstream of site

Percent Other: Percentage of other land use in catchment upstream of site (other = wetlands, barren, and water)

Water Chemistry Information

Closed pH: Lab pH, sampled in the spring. Site is shaded if value is < 5.0.

Specific Cond.: Specific Conductivity (μ mho/cm)

ANC: Acid Neutralizing Capacity (μ eq/L). Site is shaded if value is < 200 ueq/L.

Cl: Chloride (mg/L). Site is shaded if value is \geq 30 mg/L.

Nitrate-N: Nitrate Nitrogen (mg/L). Site is shaded if value is \geq 1.0 mg/L

SO4: Sulfate (mg/L). Site is shaded if value is \geq 50 mg/L.

P-P: Particulate Phosphorus (mg/L). Site is shaded if value is \geq 0.005 mg/L.

TD-P: Total Dissolved Phosphorus (mg/L). Site is shaded if value is \geq 0.0175 mg/L.

Ortho-P: Orthophosphate (mg/L). Site is shaded if value is \geq 0.005 mg/L.

Nitrite: Nitrite Nitrogen (mg/L). Site is shaded if value is \geq 0.0075 mg/L.

Ammonia: Ammonia (mg/L). Site is shaded if value is \geq 0.025 mg/L.

TD-N: Total Dissolved Nitrogen (mg/L). Site is shaded if value is \geq 2.0 mg/L.

P-N: Particulate Nitrogen (mg/L). Site is shaded if value is \geq 0.05 mg/L.

P-C: Particulate Carbon (mg/L)

DOC: Dissolved Organic Carbon (mg/L). Site is shaded if value is \geq 8.0 mg/L.

DO: Dissolved Oxygen (mg/L). Site is shaded if value is \leq 5 mg/L.

Turbidity: Turbidity (NTUs). Site is shaded if value is \geq 10 NTUs.

Table 4-1. (Continued)

Physical Habitat Condition

Riparian Buffer Width Left: Width of the riparian buffer on the left bank (meters). Site is shaded if value is < 10 m.

Riparian Buffer Width Right: Width of the riparian buffer on the right bank (meters). Site is shaded if value is < 10 m.

Adjacent Cover Left: Type of adjacent land cover on the left bank

Adjacent Cover Right: Type of adjacent land cover on the right bank

The following variables are scored on the following scale:

- 0-5 Poor
- 6-10 Marginal
- 11-15 Sub-optimal
- 16-20 Optimal

Sites are shaded if scores are ≤ 6 .

Instream Habitat Structure: Scored based on the value of instream habitat to the fish community

Epifaunal Substrate: Scored based on the amount and variety of hard, stable substrates used by benthic macroinvertebrates

Velocity/Depth Diversity: Scored based on the variety of velocity/depth regimes present at a site

Pool/Glide/Eddy Quality: Scored based on the variety and complexity of slow or still water habitat present at a site

Riffle Run Quality: Scored based on the depth, complexity, and functionality of riffle/run habitat present at a site

Extent of Pools: The extent of pools, glides, and eddys present at a site (meters). Site is shaded if value is 0 m.

Extent of Riffles: The extent of riffles and runs present at a site (meters). Site is shaded if value is 0 m.

Embeddedness: Scored as a percentage (0-100) based on the fraction of surface area of larger particles surrounded by finer sediments. Site is shaded if value is 100%.

Shading: Scored as a percentage (0-100) based on estimates of the degree and duration of shading of sites during the summer. Site is shaded if value is 0%.

Trash Rating: Scored base on the visual appeal of the site and the presence/absence of human refuse. Site is shaded if value is ≤ 6 .

Maximum Depth: Maximum depth of the stream (centimeters). Site is shaded if value is ≤ 20 cm.

Physical Habitat Modifications

Buffer Breaks?: Presence/absence of breaks in the riparian buffer, either right or left bank (Y/N). Site is shaded if value is Y.

Surface Mine?: Surface Mine present at the site (Y/N). Site is shaded if value is Y.

Landfill?: Landfill present at the site (Y/N). Site is shaded if value is Y.

Channelization: Stream channelization evident at the site (Y/N). Site is shaded if value is Y.

Erosion Severity Left - Severity of erosion on left bank (Severe, Moderate, Mild, or None). Site is shaded if value is Severe.

Erosion Severity Right - Severity of erosion on right bank. Site is shaded if value is Severe.

Bar Formation - Extent of bar formation in stream (Severe, Moderate, Mild, or None). Site is shaded if value is Severe

Table 4-1. (Continued)

Watershed Abbreviations

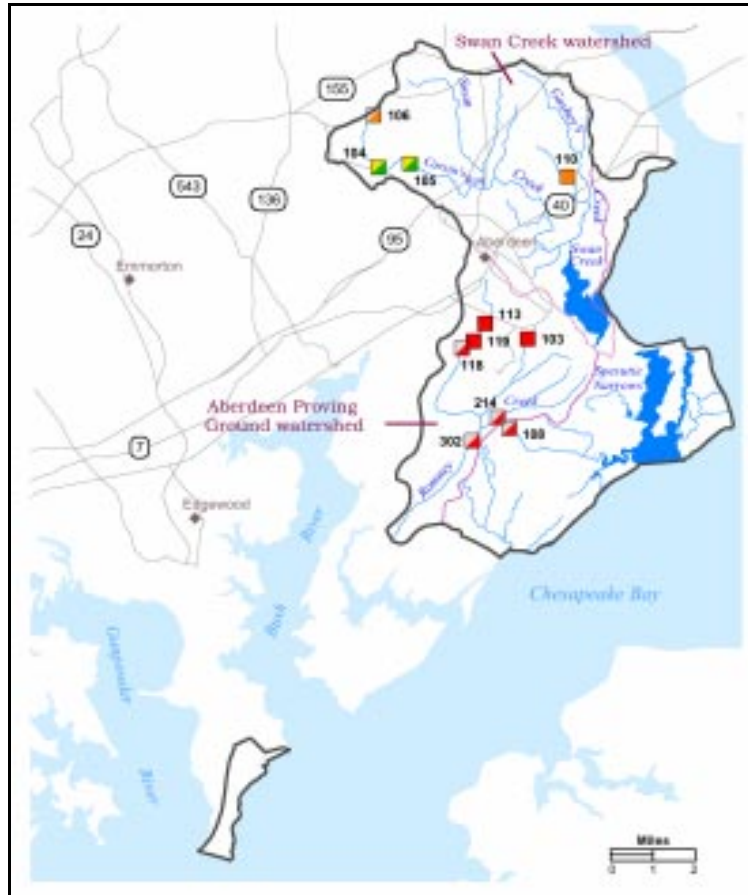
ABPG	Aberdeen Proving Grounds
BRIG	Brighton Dam
CASS	Casselman River
CORS	Corsica River
FIMI	Fifteen Mile Creek
LIBE	Liberty Reservoir
LOWI	Lower Wicomico Creek
LPAX	Little Patuxent River
LTON	Little Tonoloway
MARS	Marsh Run
MATT	Mattawoman Creek
MONI	Monie Bay
NANJ	Nanjemoy Creek
PRET	Prettyboy Reservoir
PRWA	Potomac River Washington County
SBPA	South Branch Patapsco River
SEAS	Southeast Creek
STMA	St. Mary's River
SWAN	Swan Creek
TOWN	Town Creek
UMON	Upper Monocacy
UPCK	Upper Choptank
WIRH	Wicomico River Head

Cover Type Abbreviations

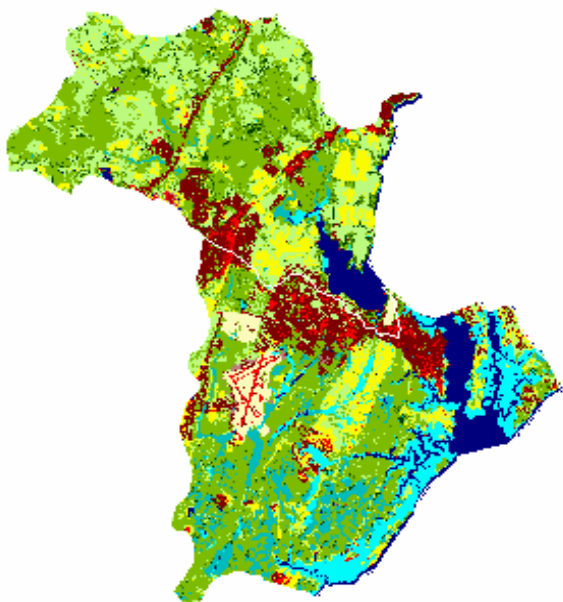
CP	Cropland
DI	Dirt Road
EM	Emergent Vegetation
FR	Forest
GR	Gravel Road
HO	Housing
LN	Mowed Lawn
LO	Logged Area
OF	Old Field
OR	Orchard
PA	Pasture
PK	Parking Lot/Industrial/Commercial
PV	Paved Road
RR	Railroad
SL	Bare Soil
TG	Tall Grass



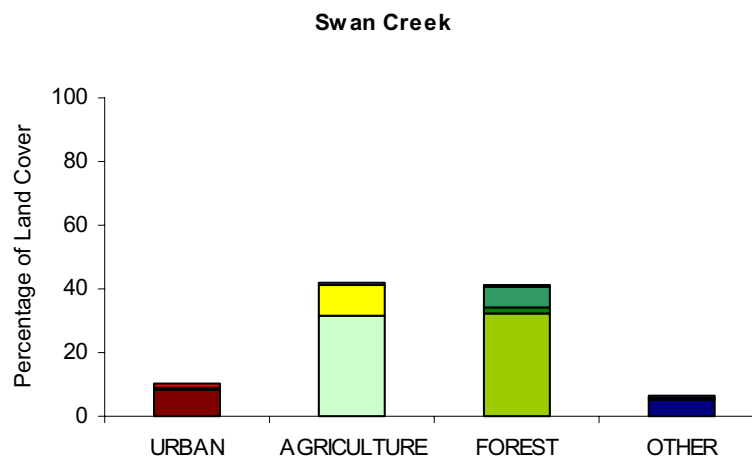
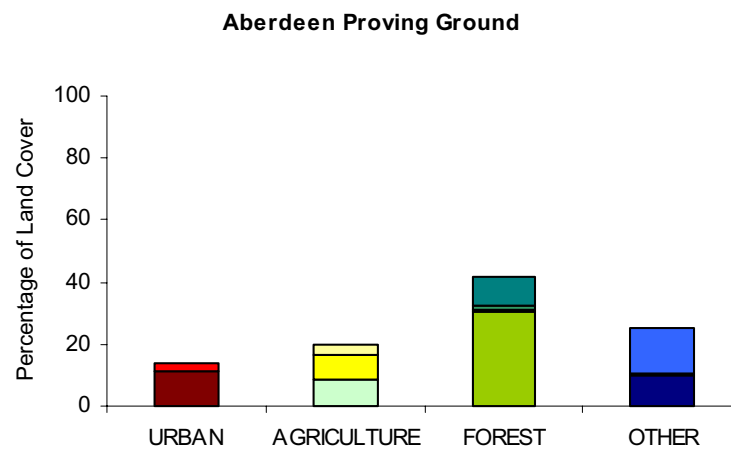
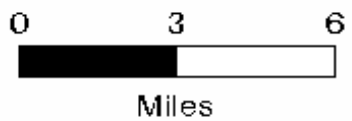
**Aberdeen Proving Ground/
Swan Creek watersheds
MBSS 2000**



Watershed	Total Land Area (acres)	Total Stream Miles
Aberdeen Proving Ground	21624	26.7
Swan Creek	16862	27.3



Aberdeen Proving Ground/Swan Creek



Aberdeen Proving Ground/Swan Creek

Site Information

Site	Stream Name	12-Digit Watershed Code	8-digit Watershed	Basin	County	Date Sampled Spring	Date Sampled Summer	Order	Catchment Area (acres)
ABPG-103-R-2000	ROMNEY CR UT2	021307051126	Aberdeen Proving Ground	BUSH RIVER	Harford	03/23/00	06/26/00	1	602
ABPG-108-R-2000	MOSQUITO CR	021307051125	Aberdeen Proving Ground	BUSH RIVER	Harford	03/23/00	06/26/00	1	34
ABPG-113-R-2000	ROMNEY CR UT1	021307051126	Aberdeen Proving Ground	BUSH RIVER	Harford	03/23/00	06/27/00	1	1161
ABPG-118-R-2000	ROMNEY CR UT1	021307051126	Aberdeen Proving Ground	BUSH RIVER	Harford	03/23/00	06/26/00	1	1616
ABPG-119-R-2000	ROMNEY CR UT1	021307051126	Aberdeen Proving Ground	BUSH RIVER	Harford	03/23/00	06/26/00	1	1393
ABPG-214-R-2000	ROMNEY CR	021307051126	Aberdeen Proving Ground	BUSH RIVER	Harford	03/21/00	NS	2	1327
ABPG-302-R-2000	ROMNEY CR	021307051126	Aberdeen Proving Ground	BUSH RIVER	Harford	03/21/00	08/21/00	3	7388
SWAN-104-R-2000	CARSINS RUN	021307061135	Swan CR	BUSH RIVER	Harford	03/20/00	06/28/00	1	1049
SWAN-105-R-2000	CARSINS RUN	021307061135	Swan CR	BUSH RIVER	Harford	03/20/00	06/28/00	1	1960
SWAN-106-R-2000	CARSINS RUN	021307061135	Swan CR	BUSH RIVER	Harford	03/20/00	08/21/00	1	252
SWAN-110-R-2000	BLENHEIM RUN	021307061135	Swan CR	BUSH RIVER	Harford	03/20/00	06/27/00	1	507

Indicator Information

Site	FIBI	BIBI	PHI	Brook Trout Present	Black Water Stream
ABPG-103-R-2000	1.00	1.29	48.81	0	0
ABPG-108-R-2000	NR	1.29	5.11	0	1
ABPG-113-R-2000	1.50	1.29	32.03	0	0
ABPG-118-R-2000	NS	1.57	NS	NS	NS
ABPG-119-R-2000	1.00	1.86	2.92	0	0
ABPG-214-R-2000	NS	1.86	NS	NS	NS
ABPG-302-R-2000	3.00	1.29	30.15	0	1
SWAN-104-R-2000	3.67	4.11	37.81	0	0
SWAN-105-R-2000	3.67	4.11	91.59	0	0
SWAN-106-R-2000	NR	2.11	2.80	0	0
SWAN-110-R-2000	2.78	2.78	21.84	0	0

Catchment Land Use Information

Site	Percent Urban	Percent Agriculture	Percent Forest	Percent Other
ABPG-103-R-2000	73.7	17.9	8.1	0.3
ABPG-108-R-2000	0.0	32.4	67.6	0.0
ABPG-113-R-2000	32.3	31.8	35.5	0.5
ABPG-118-R-2000	25.7	36.0	38.0	0.5
ABPG-119-R-2000	26.8	36.7	36.2	0.5
ABPG-214-R-2000	5.0	42.9	40.6	12.6
ABPG-302-R-2000	27.1	31.3	37.4	4.9
SWAN-104-R-2000	0.0	38.9	61.1	0.0
SWAN-105-R-2000	0.1	34.9	64.9	0.3
SWAN-106-R-2000	0.0	51.6	48.4	0.0
SWAN-110-R-2000	0.0	24.3	75.7	0.1

Interpretation of Watershed Condition

Aberdeen Proving Ground

- Extensive urban land use upstream of several sites, although all sampled sites had at least 50 m riparian buffer
- Several sites affected by channelization; several sites (e.g., 113, 118) impacted by a golf course
- Low habitat scores at Site 108 are because very small stream with no flow
- Sites 118 and 119 were impounded upstream of sites; low flow at Site 119 resulted in standing pools during summer sampling
- Beaver dam at Site 214 during spring sampling
- Phosphorous concentrations high at several sites

Swan Creek

- Site 104 had flashy flow, erosion was evident; site receives runoff from repair garage; site on fall line
- Site 106 very small stream with no flow, not severely affected otherwise
- Site 110 in golf course, poor riparian buffer

Aberdeen Proving Ground/Swan Creek

Water Chemistry Information

Site	Closed pH	Specific Cond.	ANC (ueq/L)	Cl (mg/L)	Nitrate-N (mg/L)	SO4 (mg/L)	P-P (mg/L)	TD-P (mg/L)	Ortho-P (mg/L)	Nitrite (mg/L)	Ammonia (mg/L)	TD-N (mg/L)	P-N (mg/L)	P-C (mg/L)	DOC (mg/L)	DO (mg/L)	Turbidity (NTUs)
ABPG-103-R-2000	6.93	196.6	516.5	38.647	0.157	7.829	0.009	0.031	0.012	0.000	0.002	0.620	0.123	1.134	6.026	4.3	12
ABPG-108-R-2000	5.41	49.4	61.5	1.757	0.019	8.964	0.005	0.047	0.015	0.000	0.045	0.598	0.151	1.368	17.905	1.1	14.1
ABPG-113-R-2000	6.76	82.6	353.3	8.281	0.319	5.574	0.016	0.079	0.053	0.000	0.007	0.818	0.158	1.400	7.366	3.2	4.6
ABPG-118-R-2000	6.82	88.6	369.1	9.137	0.450	6.134	0.018	0.073	0.045	0.000	0.000	1.000	0.126	1.247	7.559	NS	NS
ABPG-119-R-2000	6.96	96.3	416.6	10.295	0.346	6.166	0.017	0.073	0.043	0.000	0.000	0.825	0.101	0.953	7.793	16.3	38.1
ABPG-214-R-2000	6.67	102.0	372.8	11.637	0.000	11.031	0.007	0.029	0.002	0.000	0.000	0.621	0.098	0.693	14.252	NS	NS
ABPG-302-R-2000	6.02	161.8	154.1	34.759	0.022	11.411	0.008	0.012	0.003	0.000	0.003	0.560	0.084	0.829	15.965	4.5	55.1
SWAN-104-R-2000	7.39	141.6	616.2	20.214	0.439	6.668	0.001	0.009	0.001	0.000	0.000	0.783	0.025	0.178	6.159	7.4	4.4
SWAN-105-R-2000	7.42	141.3	604.5	18.169	0.582	9.060	0.001	0.008	0.002	0.000	0.000	0.817	0.038	0.241	4.241	6.1	4.2
SWAN-106-R-2000	6.95	116.1	367.0	17.784	0.025	8.212	0.002	0.014	0.001	0.000	0.010	0.462	0.046	0.382	13.743	4.0	51.3
SWAN-110-R-2000	7.44	93.2	392.8	8.622	0.906	8.060	0.002	0.012	0.006	0.000	0.002	1.158	0.122	0.220	2.090	8.1	3.4

Physical Habitat Condition

Site	Riparian Buffer Width Left	Riparian Buffer Width Right	Adjacent Cover Left	Adjacent Cover Right	Instream Habitat Structure	Epifaunal Substrate	Velocity/ Depth Diversity	Pool/Glide/ Eddy Quality	Extent of Pools (m)	Riffle Run Quality	Extent of Riffles (m)	Embedded-ness	Shading	Trash Rating	Maximum Depth (cm)
ABPG-103-R-2000	50	50	PV	FR	12	16	8	7	65	10	20	16	97	14	32
ABPG-108-R-2000	50	50	FR	FR	4	7	2	3	75	2	0	100	95	18	15
ABPG-113-R-2000	50	50	LN	LN	16	16	7	8	75	0	0	100	7	10	32
ABPG-118-R-2000	50	50	FR	FR	NS	NS	NS	NS	NS	NS	NS	NS	NS	17	NS
ABPG-119-R-2000	50	50	FR	FR	2	1	2	2	65	0	0	100	65	15	7
ABPG-214-R-2000	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
ABPG-302-R-2000	50	50	FR	FR	12	14	3	9	75	0	0	100	72	19	49
SWAN-104-R-2000	25	2	PK	LN	15	11	12	12	60	6	30	5	95	4	93
SWAN-105-R-2000	50	50	HO	PV	15	11	13	13	70	12	10	10	75	10	74
SWAN-106-R-2000	40	10	CP	CP	5	9	2	7	75	0	0	100	98	18	17
SWAN-110-R-2000	50	0	LN	LN	14	18	7	8	30	7	70	25	10	15	24

Physical Habitat Modifications

Site	Buffer Breaks?	Surface Mine?	Landfill?	Channelization?	Erosion Severity Left	Erosion Severity Right	Bar Formation
ABPG-103-R-2000	N	N	Y	Y	Moderate	Severe	Moderate
ABPG-108-R-2000	N	N	N	Y	None	None	None
ABPG-113-R-2000	N	N	N	Y	None	None	None
ABPG-118-R-2000	N	N	N	Y	NS	NS	NS
ABPG-119-R-2000	N	N	N	Y	None	None	Minor
ABPG-214-R-2000	N	N	N	N	NS	NS	NS
ABPG-302-R-2000	N	N	N	N	Mild	Mild	None
SWAN-104-R-2000	Y	N	N	N	None	Severe	Severe
SWAN-105-R-2000	N	N	N	Y	Mild	Mild	Moderate
SWAN-106-R-2000	N	N	N	N	Moderate	Mild	None

SWAN-110-R-2000	N	N	N	N	Mild	None	Minor
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Aberdeen Proving Ground/ Swan Creek

Fish Species Present

AMERICAN EEL
BANDED SUNFISH
BLACKNOSE DACE
BLUEGILL
BROWN BULLHEAD
COMMON SHINER
CR CHUB
CR CHUBSUCKER
CUTLIPS MINNOW
EASTERN MUDMINNOW
GOLDEN SHINER
GOLDFISH
GREEN SUNFISH
LARGEMOUTH BASS
MUMMICHOG
PUMPKINSEED
REDBREAST SUNFISH
REDFIN PICKEREL
ROSYSIDE DACE
SWALLOWTAIL SHINER
TADPOLE MADTOM
TESSELLATED DARTER
WHITE SUCKER
YELLOW BULLHEAD

Exotic Plants Present

JAPANESE HONEYSUCKLE
MICROSTEGIUM
MULTIFLORA ROSE
THISTLE

Benthic Taxa Present

ABLABESMYIA
ACENTRELLA
ACRONEURIA
AGABETES
AGABUS
AMELETUS
AMPHINEMURA
BAETIDAE
BEROSUS
BEZZIA
BRILLIA
CERATOPOGONIDAE
CHIRONOMINI
CRANGONYCTIDAE
CAECIDOTEA
CHEUMATOPSYCHE
CLINOCERA
CONCHAPELOPIA
CRANGONYX
CRICOTOPUS
CRICOTOPUS/ORTHOCLADIUS
DYTISCIDAE
DIAMESA
DICROTENDIPES
DIPLECTRONA
ENCHYTRAEIDAE
ENALLAGMA
EPEORUS
EPHEMERELLA
EUKIEFFERIELLA
EURYLOPHELLA
GOMPHIDAE
GORDIIDAE
GLYPTOTENDIPES
GYRAULUS
HELOPHORUS
HEXATOMA
HYDROPORUS
KIEFFERULUS
LUMBRICULIDAE
LIMONIA
MENETUS

NAIDIDAE
NEMOURIDAE
NEOPHYLAX
NIGRONIA
ORTHOCLADIINAE
OPTIOSERVUS
ORMOSIA
ORTHOCLADIINAE A
ORTHOCLADIUS
PERLIDAE
PERLODIDAE
PARALEPTOPHLEBIA
PARAMETRIOCNEMUS
PARAPHAENOCCLADIUS
PARATANYTARSUS
PHYSELLA
PISIDIUM
POLYPEDILUM
PROCLADIUS
PROSIMULIUM
PROSTOIA
PSEPHENUS
PSEUDOSUCCINEA
RHEOCRICOTOPUS
RHEOTANYTARSUS
RHYACOPHILA
SIMULIIDAE
SPHAERIIDAE
SIMULIUM
SMITTIA
SPHAERIUM
STAGNICOLA
STEGOPTERNA
STENELMIS
STILOBEZZIA
SYMPOSIACLADIUS
SYMPOTTHASTIA
TUBIFICIDAE
TABANUS
TANYTARSUS
THIENEMANNIELLA
TRIAENODES
WORMALDIA

Herpetofauna Present

BLACK RAT SNAKE

BULLFROG

COMMON SNAPPING TURTLE

EASTERN BOX TURTLE

FOWLER'S TOAD

GREEN FROG

NORTHERN TWO-LINED SALAMANDER

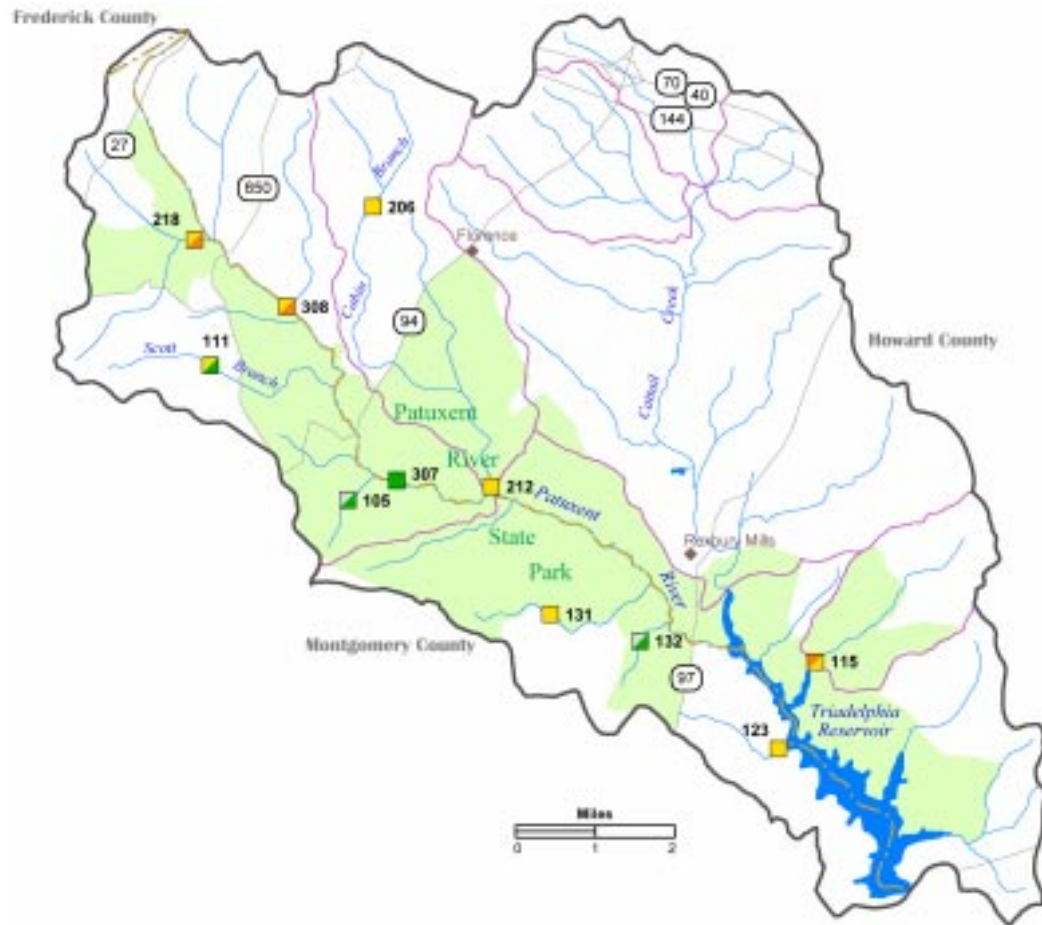
NORTHERN WATER SNAKE

PICKEREL FROG

SOUTHERN LEOPARD FROG

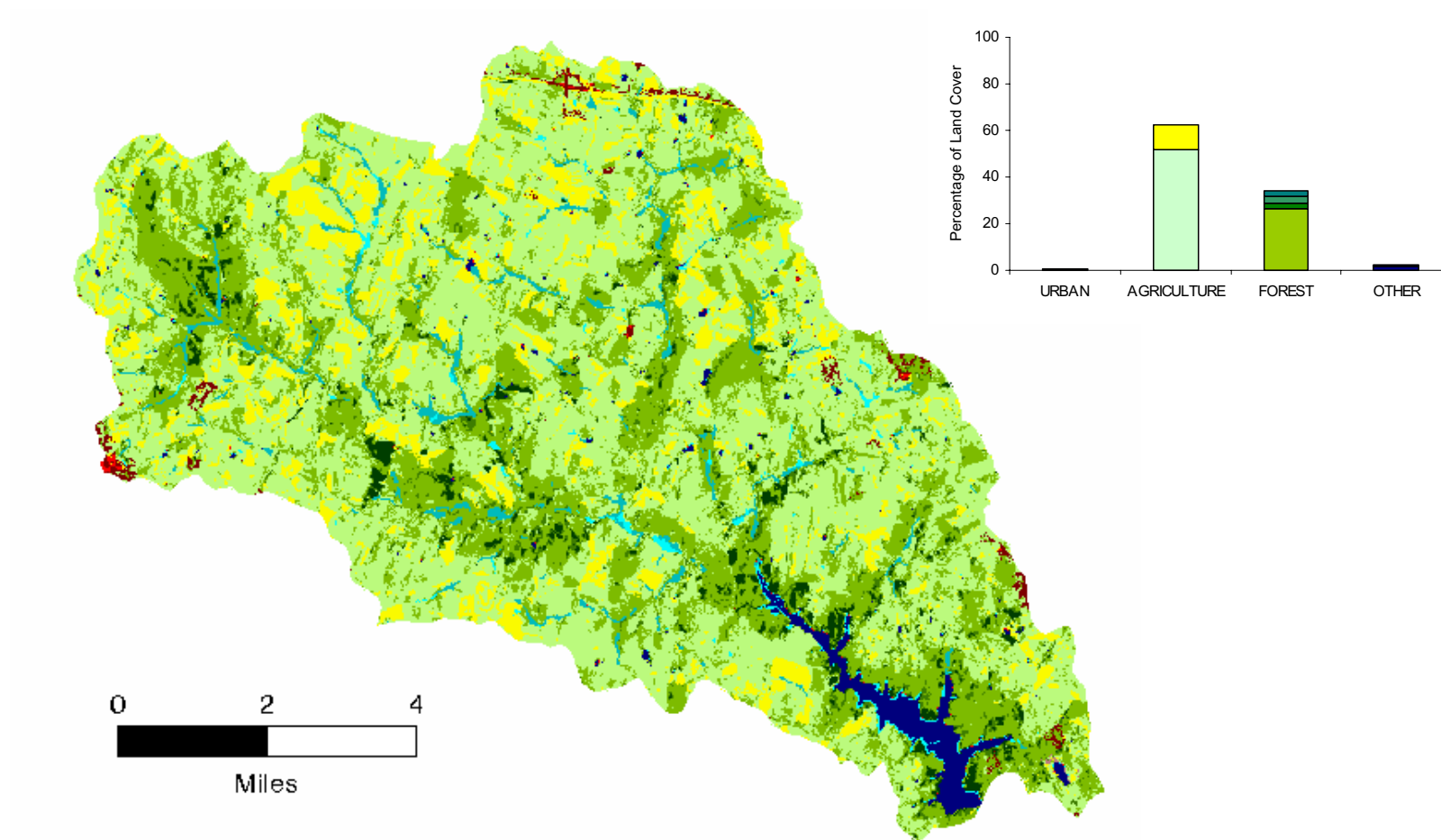


Brighton Dam watershed **MBSS 2000**



Watershed	Total Land Area (acres)	Total Stream Miles
Brighton Dam	50595	98.4

Brighton Dam



Brighton Dam

Site Information

Site	Stream Name	12-digit Subwatershed Code	8-digit Watershed	Basin	County	Date Sampled Spring	Date Sampled Summer	Order	Catchment Area (acres)
BRIG-105-R-2000	PATUXENT R UT1	021311080969	Brighton Dam	PATUXENT RIVER	Montgomery	03/13/00	07/07/00	1	162
BRIG-111-R-2000	SCOTTS BR	021311080969	Brighton Dam	PATUXENT RIVER	Montgomery	03/30/00	07/07/00	1	567
BRIG-115-R-2000	TRIDELPHIA RES UT1	021311080967	Brighton Dam	PATUXENT RIVER	Howard	03/09/00	09/13/00	1	2184
BRIG-123-R-2000	TRIDELPHIA RES UT1	021311080966	Brighton Dam	PATUXENT RIVER	Montgomery	03/13/00	09/13/00	1	710
BRIG-131-R-2000	HAIGHTS BR UT1	021311080966	Brighton Dam	PATUXENT RIVER	Montgomery	03/14/00	07/17/00	1	560
BRIG-132-R-2000	PATUXENT R UT1	021311080966	Brighton Dam	PATUXENT RIVER	Montgomery	03/13/00	06/26/00	1	216
BRIG-206-R-2000	CABIN BR	021311080970	Brighton Dam	PATUXENT RIVER	Howard	03/09/00	07/12/00	2	1824
BRIG-212-R-2000	CABIN BR	021311080970	Brighton Dam	PATUXENT RIVER	Howard	03/13/00	07/10/00	2	5680
BRIG-218-R-2000	PATUXENT R UT1	021311080969	Brighton Dam	PATUXENT RIVER	Montgomery	03/09/00	07/10/00	2	2048
BRIG-307-R-2000	PATUXENT R MAINSTEM	021311080969	Brighton Dam	PATUXENT RIVER	Montgomery, Howard	03/08/00	08/17/00	3	10392
BRIG-308-R-2000	PATUXENT R MAINSTEM	021311080969	Brighton Dam	PATUXENT RIVER	Howard, Montgomery	03/08/00	08/17/00	3	5204

Indicator Information

Site	FIBI	BIBI	PHI	Brook Trout Present	Black Water Stream
BRIG-105-R-2000	NR	4.56	45.25	0	0
BRIG-111-R-2000	3.00	4.78	37.81	0	0
BRIG-115-R-2000	2.56	3.89	77.24	0	0
BRIG-123-R-2000	3.89	3.67	90.60	0	0
BRIG-131-R-2000	3.67	3.22	82.77	0	0
BRIG-132-R-2000	NR	4.33	89.69	0	0
BRIG-206-R-2000	3.67	3.67	88.29	0	0
BRIG-212-R-2000	3.22	3.89	97.77	0	0
BRIG-218-R-2000	3.89	2.11	93.04	0	0
BRIG-307-R-2000	4.33	4.11	99.86	0	0
BRIG-308-R-2000	3.67	2.33	94.79	0	0

Catchment Land Use Information

Site	Percent Urban	Percent Agriculture	Percent Forest	Percent Other
BRIG-105-R-2000	0.0	81.8	18.2	0.0
BRIG-111-R-2000	2.7	76.4	20.7	0.7
BRIG-115-R-2000	0.0	63.6	36.4	0.2
BRIG-123-R-2000	0.0	78.7	21.3	0.0
BRIG-131-R-2000	0.1	78.3	21.1	0.6
BRIG-132-R-2000	0.0	61.8	38.2	0.3
BRIG-206-R-2000	0.0	85.4	13.0	1.6
BRIG-212-R-2000	0.0	72.6	26.5	1.0
BRIG-218-R-2000	4.9	64.6	30.1	0.9
BRIG-307-R-2000	1.3	62.0	36.5	0.4
BRIG-308-R-2000	2.0	52.9	44.9	0.5

Interpretation of Watershed Condition

- All sites have large amounts of agricultural land in the upstream catchment; nitrogen and phosphorous concentrations are high
- Pasture and other agricultural impacts are evident (Sites 105, 111, 131, 132, 212, 308)
- Many sites located on public lands with recreational activity (biking, horseback riding, etc.); most sites have 50 m riparian buffer
- Several sites have large amounts of bank erosion
- New construction upstream of Site 123, lots of fine sediments

Brighton Dam

Water Chemistry Information

Site	Closed pH	Specific Cond.	ANC (ueq/L)	Cl (mg/L)	Nitrate-N (mg/L)	SO4 (mg/L)	P-P (mg/L)	TD-P (mg/L)	Ortho-P (mg/L)	Nitrite (mg/L)	Ammonia (mg/L)	TD-N (mg/L)	P-N (mg/L)	P-C (mg/L)	DOC (mg/L)	DO (mg/L)	Turbidity (NTUs)
BRIG-105-R-2000	6.88	87.8	318.9	10.303	1.247	2.934	0.003	0.008	0.003	0.013	0.026	1.303	0.026	0.278	0.862	8.3	5.3
BRIG-111-R-2000	6.97	127.6	237.9	16.812	3.755	4.297	0.001	0.008	0.001	0.000	0.000	3.963	0.022	0.132	1.481	7.9	3.6
BRIG-115-R-2000	7.59	174.0	560.7	18.928	2.894	12.108	0.005	0.024	0.016	0.019	0.025	3.065	0.031	0.269	1.435	7.9	2.8
BRIG-123-R-2000	6.96	124.4	300.6	14.355	2.821	6.866	0.005	0.012	0.002	0.013	0.027	3.166	0.042	0.481	2.064	8.0	10.3
BRIG-131-R-2000	6.89	75.5	270.2	5.411	2.222	2.190	0.005	0.008	0.002	0.008	0.025	2.545	0.074	0.811	1.571	8.4	14
BRIG-132-R-2000	6.92	123.0	323.7	18.801	1.037	5.723	0.003	0.010	0.003	0.007	0.009	1.118	0.057	0.698	1.613	7.8	8.9
BRIG-206-R-2000	6.77	124.7	215.5	16.635	4.344	2.523	0.003	0.007	0.000	0.012	0.024	4.382	0.016	0.243	1.244	8.3	8
BRIG-212-R-2000	7.08	125.3	288.9	16.656	2.895	4.721	0.003	0.009	0.003	0.009	0.014	3.520	0.041	0.267	1.678	8.2	9.7
BRIG-218-R-2000	7.14	182.4	300.8	31.652	3.447	6.173	0.001	0.005	0.000	0.009	0.016	3.524	0.023	0.227	1.009	7.1	4.4
BRIG-307-R-2000	7.14	136.4	263.7	20.139	2.851	5.191	0.001	0.007	0.000	0.009	0.010	2.993	0.028	0.222	0.968	8.2	3.5
BRIG-308-R-2000	7.31	145.7	309.2	23.321	2.694	6.040	0.001	0.005	0.001	0.008	0.009	2.711	0.112	0.310	0.966	8.4	1.1

Physical Habitat Condition

Site	Riparian Buffer Width Left	Riparian Buffer Width Right	Adjacent Cover Left	Adjacent Cover Right	Instream Habitat Structure	Epifaunal Substrate	Velocity/Depth Diversity	Pool/Glide/Eddy Quality	Extent of Pools (m)	Riffle Run Quality	Extent of Riffles (m)	Embedded-ness	Shading	Trash Rating	Maximum Depth (cm)
BRIG-105-R-2000	50	50	FR	FR	11	13	7	7	12	11	65	20	90	19	21
BRIG-111-R-2000	20	50	PA	FR	13	14	8	10	37	12	38	15	90	16	44
BRIG-115-R-2000	50	50	FR	FR	8	9	12	13	57	11	18	35	85	16	109
BRIG-123-R-2000	50	50	FR	FR	14	12	13	12	45	13	30	20	95	19	77
BRIG-131-R-2000	50	50	CP	CP	15	12	13	12	41	14	34	20	75	14	72
BRIG-132-R-2000	50	50	FR	FR	11	11	7	9	39	9	36	35	90	15	27
BRIG-206-R-2000	50	50	FR	FR	15	16	14	14	47	14	28	10	85	19	82
BRIG-212-R-2000	50	50	FR	FR	14	14	15	14	40	15	45	20	85	17	84
BRIG-218-R-2000	50	50	FR	FR	15	17	14	14	46	15	29	20	90	15	69
BRIG-307-R-2000	50	50	FR	FR	17	14	16	18	65	16	19	30	80	19	137
BRIG-308-R-2000	50	50	FR	FR	14	17	12	13	62	14	38	25	90	18	80

Physical Habitat Modifications

Site	Buffer Breaks?	Surface Mine?	Landfill?	Channelization?	Erosion Severity Left	Erosion Severity Right	Bar Formation
BRIG-105-R-2000	N	N	N	N	Moderate	Moderate	Minor
BRIG-111-R-2000	N	N	N	N	Severe	Severe	Moderate
BRIG-115-R-2000	N	N	N	N	Moderate	Moderate	Moderate
BRIG-123-R-2000	N	N	N	N	Mild	Mild	None
BRIG-131-R-2000	N	N	N	N	Moderate	Moderate	Minor
BRIG-132-R-2000	Y	N	N	N	Moderate	Moderate	Moderate
BRIG-206-R-2000	N	N	N	N	Severe	Severe	Moderate
BRIG-212-R-2000	Y	N	N	N	Moderate	Moderate	Severe
BRIG-218-R-2000	N	N	N	N	Severe	Severe	Severe
BRIG-307-R-2000	N	N	N	N	Moderate	Severe	Moderate
BRIG-308-R-2000	N	N	N	N	Moderate	Mild	Moderate

Brighton Dam

Fish Species Present

BLACKNOSE DACE
BLUEGILL
BROWN BULLHEAD
BROWN TROUT
CENTRAL STONEROLLER
COMMON SHINER
CREEK CHUB
CUTLIPS MINNOW
FALLFISH
GIZZARD SHAD
GOLDEN SHINER
GREEN SUNFISH
LARGEMOUTH BASS
LONGNOSE DACE
MARGINED MADTOM
NORTHERN HOGSUCKER
RAINBOW TROUT
REDBREAST SUNFISH
RIVER CHUB
ROSYSIDE DACE
SHIELD DARTER
SMALLMOUTH BASS
SPOTFIN SHINER
SPOTTAIL SHINER
TESSELLATED DARTER
WHITE SUCKER
YELLOW BULLHEAD

Exotic Plants Present

JAPANESE HONEYSUCKLE
MICROSTEGIUM
MILE-A-MINUTE
MULTIFLORA ROSE

Benthic Taxa Present

ABLABESMYIA
ACERPENNA
ALLOCAPNIA
AMELETUS
AMPHINEMURA
ANCYRONYX
ANTOCHA
BRILLIA
CAMBARIDAE
COLLEMBOLA
CAENIS
CALOPTERYX
CENTROPTILUM
CERATOPOGON
CHELIFERA
CHEUMATOPSYCHE
CHIMARRA
CHIRONOMUS
CLINOCERA
CLIOPERLA
CONCHAPELOPIA
CORDULEGASTER
CORYNONEURA
CRICOTOPUS
CRICOTOPUS/ORTHOCLADIUS
CULTUS
DICRANOTA
DINEUTUS
DIPHETOR
DIPLECTRONA
DIPLOCLADIUS
DRUNELLA
DUBIRAPHIA
DUGESIA
EPHEMERELLIDAE
EPEORUS
EPHEMERELLA
EUKIEFFERIELLA
EURYLOPHELLA
GOMPHIDAE
GORDIIDAE
GLOSSOSOMA
HEPTAGENIIDAE
HELENIELLA
HEXATOMA
HYDROBAENUS
HYDROPSYCHE
ISONYCHIA
LUMBRICULIDAE

LEPTOPHLEBIA
LEUCTRA
LIMNOPORUS
LYPE
MEROPELOPIA
MICROPSECTRA
MICROTENDIPES
MICROVELIA
NAIDIDAE
NEMOURIDAE
NEOPHYLAX
NIGRONIA
ORTHOCLADIINAE A
OEMOPTERYX
OPTIOSERVUS
ORTHOCLADIINAE A
ORTHOCLADIUS
OULIMNIUS
PERLODIDAE
PHILOPOTAMIDAE
PARALEPTOPHLEBIA
PARAMETRIOCNEMUS
POLYCENTROPUS
POLYPEDILUM
POTTHASTIA
PROSIMULIUM
PROSTOIA
PSEPHENUS
PSILOTRETA
PSYCHOMYIA
PTILOSTOMIS
PYCNOPSYCHE
RHEOCRICOTOPUS
RHEOTANYTARSUS
RHYACOPHILA
SIMULIIDAE
SERRATELLA
SIALIS
SIMULIUM
STEGOPTERNA
STEMPELLINELLA
STENACRON
STENELMIS
STENONEMA
STICTOCHIRONOMUS
STILOCLADIUS
STROPHOPTERYX
STYLOGOMPHUS
SYMPOSIACLADIUS
SYMPOTTHASTIA
TUBIFICIDAE

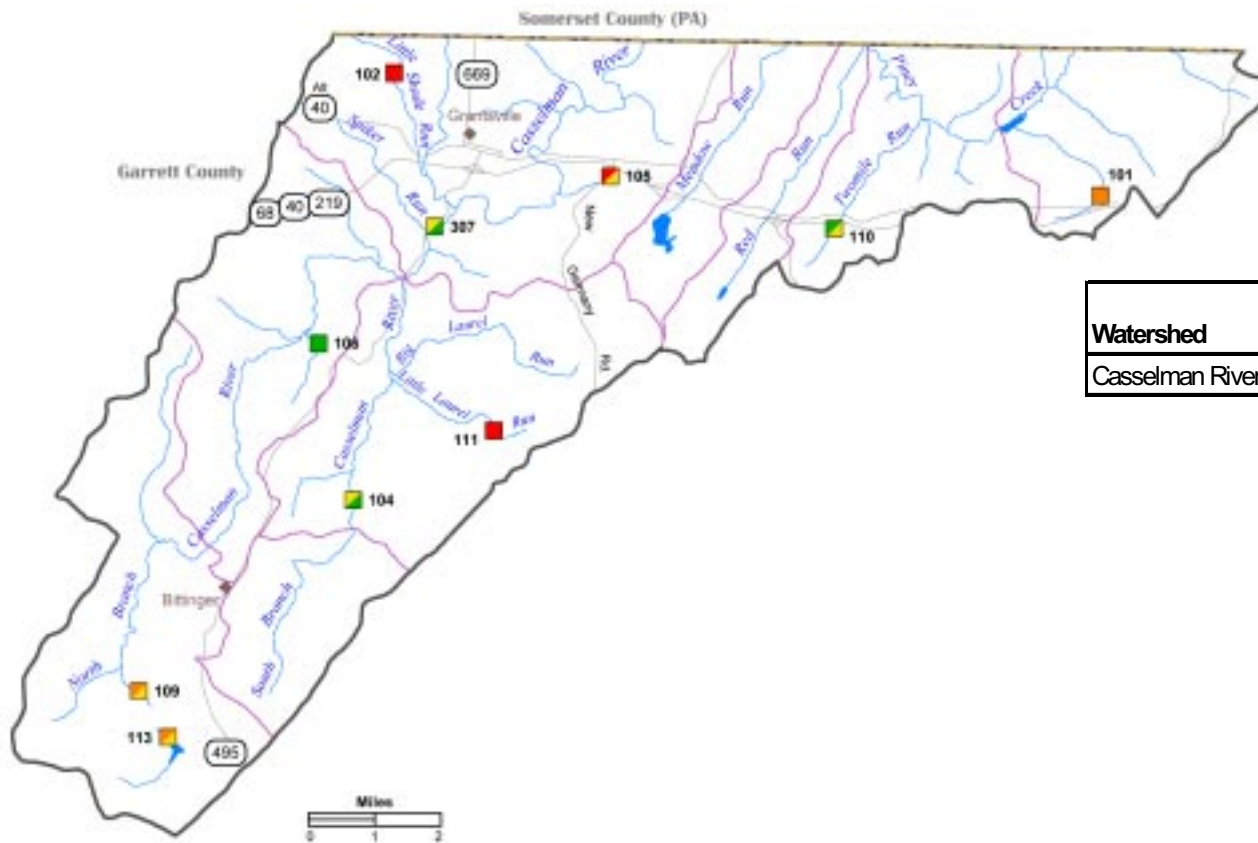
TANYTARSUS
THIENEMANNIELLA
TIPULA
TRISSOPELOPIA
TVETENIA
XYLOTOPUS
ZAVRELIMYIA

Herpetofauna Present

AMERICAN TOAD
BULLFROG
EASTERN PAINTED TURTLE
FOWLER'S TOAD
GREEN FROG
NORTHERN DUSKY SALAMANDER
NORTHERN TWO-LINED SALAMANDER
PICKEREL FROG
QUEEN SNAKE
RED SALAMANDER
WOOD FROG

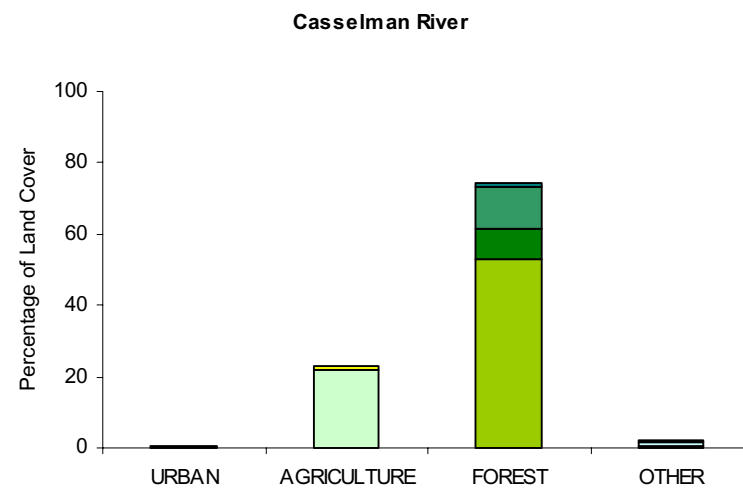
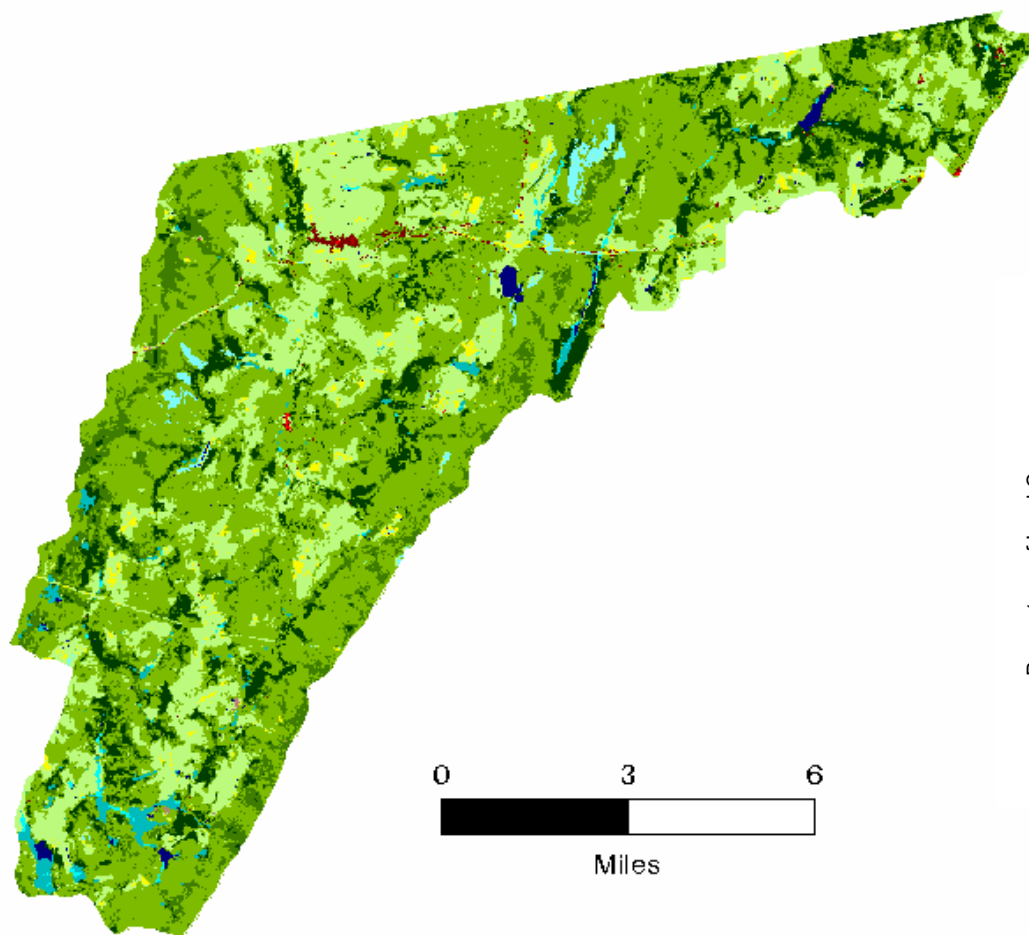


Casselman River watershed MBSS 2000



Watershed	Total Land Area (acres)	Total Stream Miles
Casselman River	58588	88.5

Casselman River



Casselman River

Site Information

Site	Stream Name	12-digit Subwatershed Code	8-digit Watershed	Basin	County	Date Sampled Spring	Date Sampled Summer	Order	Catchment Area (acres)
CASS-101-R-2000	PINEY CR UT1	050202040038	Casselman River	YOUGHIOGHENY RIVER	Garrett	04/06/00	06/01/00	1	375
CASS-102-R-2000	LITTLE SHADE RUN	050202040034	Casselman River	YOUGHIOGHENY RIVER	Garrett	03/22/00	07/25/00	1	477
CASS-104-R-2000	SOUTH BR CASSELMAN R	050202040033	Casselman River	YOUGHIOGHENY RIVER	Garrett	04/06/00	07/27/00	1	5018
CASS-105-R-2000	CASSELMAN RIVER UT1	050202040034	Casselman River	YOUGHIOGHENY RIVER	Garrett	03/22/00	07/27/00	1	312
CASS-106-R-2000	NORTH BR CASSELMAN R UT1	050202040032	Casselman River	YOUGHIOGHENY RIVER	Garrett	03/22/00	07/12/00	1	610
CASS-109-R-2000	NORTH BR CASSELMAN R	050202040030	Casselman River	YOUGHIOGHENY RIVER	Garrett	04/06/00	07/26/00	1	2570
CASS-110-R-2000	TWOMILE RUN	050202040037	Casselman River	YOUGHIOGHENY RIVER	Garrett	03/22/00	08/01/00	1	582
CASS-111-R-2000	LITTLE LAUREL RUN	050202040033	Casselman River	YOUGHIOGHENY RIVER	Garrett	03/22/00	07/27/00	1	327
CASS-113-R-2000	NORTH BR CASSELMAN R	050202040030	Casselman River	YOUGHIOGHENY RIVER	Garrett	04/06/00	07/26/00	1	1306
CASS-307-R-2000	CASSELMAN RIVER	050202040034	Casselman River	YOUGHIOGHENY RIVER	Garrett	04/12/00	08/16/00	3	3242

Indicator Information

Site	FIBI	BIBI	PHI	Brook Trout Present	Black Water Stream
CASS-101-R-2000	2.71	2.33	49.84	0	0
CASS-102-R-2000	1.00	1.22	44.74	0	0
CASS-104-R-2000	3.86	4.78	77.95	1	0
CASS-105-R-2000	1.00	3.89	48.82	0	0
CASS-106-R-2000	4.14	4.56	69.26	1	0
CASS-109-R-2000	2.43	3.22	99.83	0	0
CASS-110-R-2000	4.43	3.67	25.53	1	0
CASS-111-R-2000	1.00	1.67	21.14	0	0
CASS-113-R-2000	2.14	3.67	81.27	0	0
CASS-307-R-2000	3.57	4.78	71.81	0	0

Catchment Land Use Information

Site	Percent Urban	Percent Agriculture	Percent Forest	Percent Other
CASS-101-R-2000	1.8	40.4	57.3	0.8
CASS-102-R-2000	0.1	16.7	83.1	0.1
CASS-104-R-2000	0.0	21.4	78.3	0.5
CASS-105-R-2000	1.7	14.7	80.8	3.2
CASS-106-R-2000	0.0	21.5	78.5	0.1
CASS-109-R-2000	0.1	10.1	88.7	2.3
CASS-110-R-2000	0.5	43.9	55.0	1.1
CASS-111-R-2000	0.0	4.1	95.9	0.3
CASS-113-R-2000	0.0	6.1	93.3	2.5
CASS-307-R-2000	0.1	20.1	78.8	1.4

Interpretation of Watershed Condition

- Sites 101,105, and 110 have very high conductivity and chloride concentrations and are near I-68, so may be impacted by road salt
- Several sites have low ANC values and high SO₄ - possible AMD impacts. Site 106 is near an abandoned coal mine and Site 111 is near an abandoned mine seep
- 10 m of segment at Site 111 were dry in summer
- Many sites in forested catchments, some with substantial agriculture; many sites have problems with siltation and agricultural impacts
- Sites 101 and 106 are impacted by cattle grazing / trampling
- Site 102 mostly forested with very wide buffers; source of elevated ammonia unknown. Acid deposition likely here

- Tributaries to North Branch Casselman River from west known to be mostly $ANC < 0$ and $pH < 5$. Typical of poor buffering capacity / poor weatherability of geologic formations

Casselman River

Water Chemistry Information

Site	Closed pH	Specific Cond.	ANC (ueq/L)	Cl (mg/L)	Nitrate-N (mg/L)	SO4 (mg/L)	P-P (mg/L)	TD-P (mg/L)	Ortho-P (mg/L)	Nitrite (mg/L)	Ammonia (mg/L)	TD-N (mg/L)	P-N (mg/L)	P-C (mg/L)	DOC (mg/L)	DO (mg/L)	Turbidity (NTUs)
CASS-101-R-2000	7.50	943.4	449.9	254.000	1.039	13.533	0.001	0.008	0.002	0.000	0.000	1.318	0.023	0.335	1.822	7.1	3.3
CASS-102-R-2000	5.30	38.2	9.2	1.539	0.203	10.047	0.001	0.003	0.000	0.000	0.117	0.412	0.022	0.268	1.386	8.6	2.6
CASS-104-R-2000	7.02	96.0	130.4	6.488	0.488	22.479	0.001	0.006	0.000	0.000	0.000	0.653	0.013	0.264	1.402	8.6	0.9
CASS-105-R-2000	7.36	1414.8	680.8	379.300	1.429	24.345	0.002	0.009	0.004	0.000	0.000	1.737	0.028	0.274	1.732	7.7	1.5
CASS-106-R-2000	6.86	199.4	163.5	47.045	0.638	9.521	0.002	0.006	0.000	0.000	0.000	0.878	0.034	0.418	2.140	8.4	4.4
CASS-109-R-2000	5.70	120.1	14.5	13.811	0.120	26.283	0.000	0.004	0.000	0.000	0.000	0.273	0.011	0.220	1.776	6.0	2.9
CASS-110-R-2000	7.41	1046.7	456.8	277.770	1.562	17.228	0.001	0.006	0.003	0.000	0.000	1.787	0.030	0.207	1.378	7.9	4
CASS-111-R-2000	4.80	43.0	-26.9	0.817	0.008	13.218	0.001	0.005	0.000	0.000	0.000	0.105	0.041	0.741	3.708	8.3	0.5
CASS-113-R-2000	5.63	61.5	8.8	4.150	0.100	16.613	0.000	0.005	0.001	0.000	0.000	0.207	0.022	0.320	0.907	7.2	1.9
CASS-307-R-2000	6.93	112.2	131.2	12.899	0.400	19.929	0.001	0.013	0.001	0.006	0.022	0.538	0.019	0.312	1.463	7.5	2.3

Physical Habitat Condition

Site	Riparian Buffer Width Left	Riparian Buffer Width Right	Adjacent Cover Left	Adjacent Cover Right	Instream Habitat Structure	Epifaunal Substrate	Velocity/ Depth Diversity	Pool/Glide / Eddy Quality	Extent of Pools (m)	Riffle Run Quality	Extent of Riffles (m)	Embedded-ness	Shading	Trash Rating	Maximum Depth (cm)
CASS-101-R-2000	0	0	PA	PA	16	4	14	16	72	8	15	65	45	10	54
CASS-102-R-2000	50	50	FR	CP	16	16	7	6	25	11	65	15	95	20	26
CASS-104-R-2000	50	3	FR	PA	17	17	10	10	40	13	40	15	75	11	39
CASS-105-R-2000	36	21	PV	GR	13	15	7	5	25	11	60	25	90	18	17
CASS-106-R-2000	0	0	PA	PA	16	12	12	13	30	15	55	35	70	15	48
CASS-109-R-2000	50	50	FR	FR	18	13	6	18	75	0	0	40	20	20	99
CASS-110-R-2000	50	50	FR	FR	13	10	8	10	65	8	12	35	98	20	36
CASS-111-R-2000	50	50	FR	FR	11	7	6	6	55	7	15	35	97	20	34
CASS-113-R-2000	50	50	FR	FR	11	14	6	9	65	7	20	15	95	19	46
CASS-307-R-2000	50	50	OF	CP	10	14	9	14	75	0	0	25	35	15	76

Physical Habitat Modifications

Site	Buffer Breaks?	Surface Mine?	Landfill?	Channelization?	Erosion Severity Left	Erosion Severity Right	Bar Formation
CASS-101-R-2000	Y	N	N	N	Severe	Severe	None
CASS-102-R-2000	N	N	N	N	None	None	None
CASS-104-R-2000	Y	N	N	N	None	Mild	Minor
CASS-105-R-2000	N	N	N	N	Mild	Mild	Moderate
CASS-106-R-2000	Y	Y	N	N	Moderate	Moderate	Moderate
CASS-109-R-2000	N	N	N	N	None	None	None
CASS-110-R-2000	N	N	N	N	Moderate	Moderate	Moderate
CASS-111-R-2000	N	N	N	N	None	None	Moderate
CASS-113-R-2000	Y	N	N	Y	Moderate	None	Moderate
CASS-307-R-2000	N	N	N	N	Mild	Mild	Moderate

Casselman River

Fish Species Present

BLACKNOSE DACE
BLUEGILL
BLUNTNOST MINNOW
BROOK TROUT
BROWN BULLHEAD
COMMON SHINER
CREEK CHUB
GOLDEN SHINER
JOHNNY DARTER
MOTTLED SCULPIN
NORTHERN HOGSUCKER
PUMPKINSEED
RIVER CHUB
ROCK BASS
SMALLMOUTH BASS
STRIPED SHINER
WHITE SUCKER

Exotic Plants Present

THISTLE

Benthic Taxa Present

ACERPENNA
AMPHINEMURA
ANTOCHA
APSECTROTANYPUS
ARGIA
BAETIDAE
BAETIS
CAMBARIDAE
CERATOPOGONIDAE
CHLOROPERLIDAE
COENAGRIONIDAE
CAENIS
CAMBARUS
CENTROPTILUM
CERATOPOGON
CHELIFERA
CHEUMATOPSYCHE
CHIMARRA
CHRYSOPTERUS
CINYGOMULA
CLADOPELMA
CLINOTANYPUS
CNEPHIA
CONCHAPELOPIA
CORYNONEURA
CRICOTOPUS/ORTHOCLADIUS
CRYPTOCHIRONOMUS
CULICOIDES
DIAMESINAE
DIAMESA
DICRANOTA
DICROTENDIPES
DIPLECTRONA
DIPLOCLADIUS
DOLOPHILODES
DUBIRAPHIA
ECTOPRIA
ENDOCHIRONOMUS
EPEORUS
EPHEMERELLA
EUKIEFFERIELLA
EURYLOPHELLA
GOERA
HEPTAGENIIDAE
HELENIELLA
HETEROTRISOCLADIUS
HEXATOMA
HYALELLA

HYDROPSYCHE

ISOPERLA
LEPTOPHLEBIIDAE
LEUCTRIDAE
LUMBRICULIDAE
LYMNAEIDAE
LEPIDOSTOMA
LEUCTRA
LIMNOPHYES
MEROPELOPIA
MICROPSECTRA
MICROTENDIPES
NAIDIDAE
NEMOURIDAE
NANOCLADIUS
NEOPHYLAX
NIGRONIA
ORTHOCLADIINAE
OECETIS
OPTIOSERVUS
ORMOSIA
OULIMNIUS
PERLIDAE
PERLODIDAE
PHYSIDAE
POLYCENTROPIDAE
PARACHAETOCCLADIUS
PARALEPTOPHLEBIA
PARAMETRIOCNEMUS
PARANEMOURA
PENTAGENIA
PLATYCENTROPUS
POLYCENTROPUS
POLYPEDILUM
PROBEZZIA
PROMOESIA
PROSIMULIUM
PSEUDOLIMNOPHILA
PSYCHODA
PTERONARCYS
PYCNOPSYCHE
RHEOCRICOTOPUS
RHYACOPHILA
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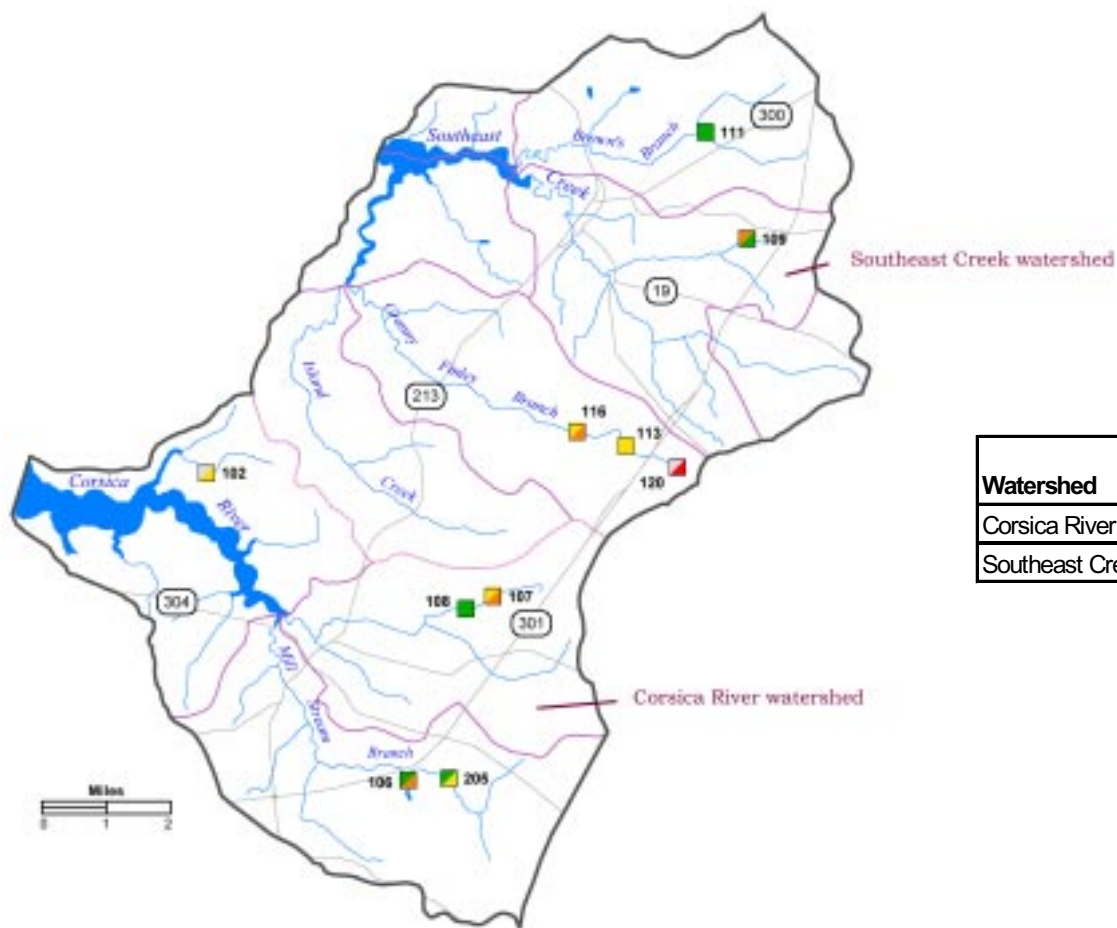
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TUBIFICIDAE
TALLAPERLA
TANYTARSUS
THIENEMANNIELLA
TRIAENODES
TRISOPELOPIA
TVETENIA
ZAVRELIMYIA

Herpetofauna Present

COMMON SNAPPING TURTLE
EASTERN GARTER SNAKE
GREEN FROG
MOUNTAIN DUSKY SALAMANDER
NORTHERN DUSKY SALAMANDER
NORTHERN SPRING PEEPER
NORTHERN SPRING SALAMANDER
NORTHERN TWO-LINED SALAMANDER
NORTHERN WATER SNAKE
RED SPOTTED NEWT

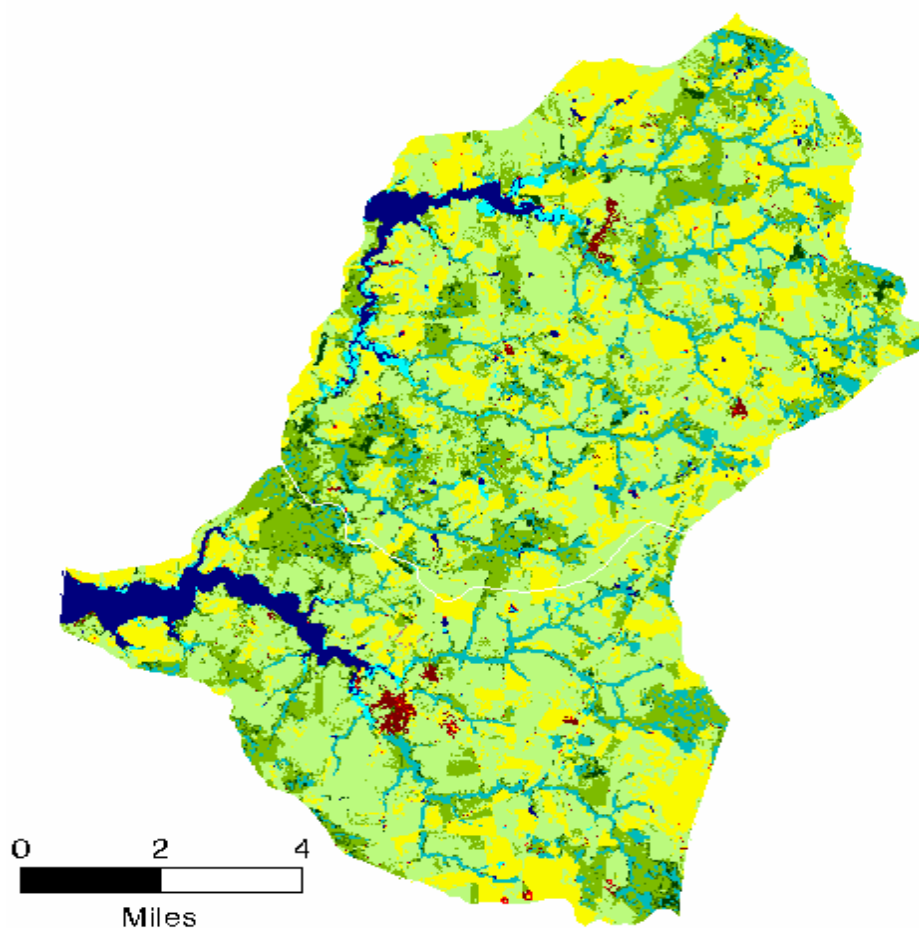


**Corsica River/Southeast
Creek watersheds
MBSS 2000**

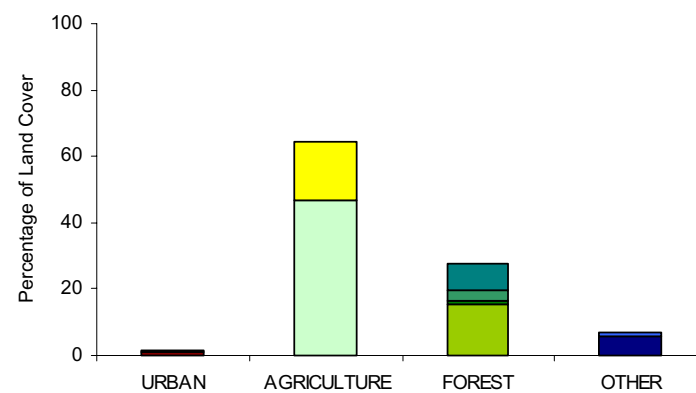


Watershed	Total Land Area (acres)	Total Stream Miles
Corsica River	25297	28.1
Southeast Creek	35456	43.9

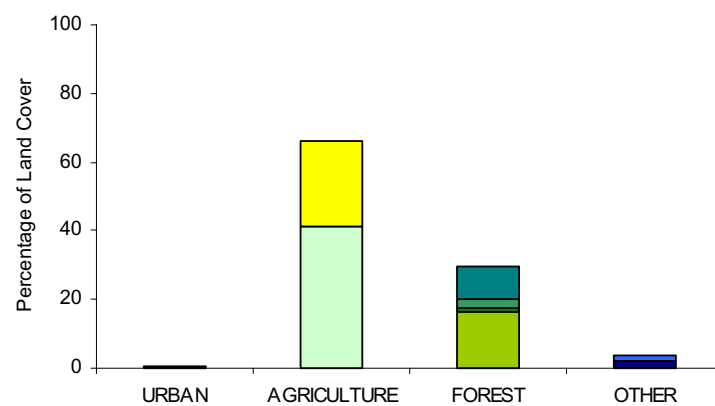
Corsica River/Southeast Creek



Corsica River



Southeast Creek



Corsica River/Southeast Creek

Site Information

Site	Stream Name	12-digit Subwatershed Code	8-digit Watershed	Basin	County	Date Sampled Spring	Date Sampled Summer	Order	Catchment Area (acres)
CORS-102-R-2000	KIRBY CR UT1	021305070395	Corsica River	CHESTER RIVER	Queen Annes	04/12/00	08/03/00	1	569
CORS-106-R-2000	MILL STREAM BR UT1	021305070396	Corsica River	CHESTER RIVER	Queen Annes	04/12/00	08/01/00	1	564
CORS-107-R-2000	THREE BRIDGES BR UT1	021305070397	Corsica River	CHESTER RIVER	Queen Annes	04/12/00	08/02/00	1	1105
CORS-108-R-2000	THREE BRIDGES BR UT1	021305070397	Corsica River	CHESTER RIVER	Queen Annes	04/03/00	08/02/00	1	1766
CORS-205-R-2000	MILL STREAM BR	021305070396	Corsica River	CHESTER RIVER	Queen Annes	04/12/00	08/10/00	2	3191
SEAS-109-R-2000	SOUTHEAST CR UT1	021305080401	Southeast CR	CHESTER RIVER	Queen Annes	04/03/00	08/10/00	1	721
SEAS-111-R-2000	BROWNS BR UT1	021305080401	Southeast CR	CHESTER RIVER	Queen Annes	04/03/00	08/03/00	1	1716
SEAS-113-R-2000	GRANNY FINLEY BR	021305080401	Southeast CR	CHESTER RIVER	Queen Annes	04/03/00	08/08/00	1	616
SEAS-116-R-2000	GRANNY FINLEY BR	021305080403	Southeast CR	CHESTER RIVER	Queen Annes	03/21/00	08/08/00	1	1805
SEAS-120-R-2000	GRANNY FINLEY BR UT1	021305080399	Southeast CR	CHESTER RIVER	Queen Annes	04/03/00	08/03/00	1	111

Indicator Information

Site	FIBI	BIBI	PHI	Brook Trout Present	Black Water Stream
CORS-102-R-2000	NR	3.29	51.02	0	1
CORS-106-R-2000	4.25	2.14	65.12	0	0
CORS-107-R-2000	3.50	2.71	53.49	0	0
CORS-108-R-2000	4.00	4.71	85.71	0	0
CORS-205-R-2000	4.75	3.86	65.87	0	0
SEAS-109-R-2000	2.75	4.14	55.94	0	0
SEAS-111-R-2000	4.50	4.43	20.10	0	0
SEAS-113-R-2000	3.50	3.00	34.98	0	0
SEAS-116-R-2000	3.00	2.43	54.31	0	0
SEAS-120-R-2000	NR	1.57	2.00	0	0

Catchment Land Use Information

Site	Percent Urban	Percent Agriculture	Percent Forest	Percent Other
CORS-102-R-2000	0.1	10.0	89.9	0.1
CORS-106-R-2000	1.1	79.8	19.1	1.0
CORS-107-R-2000	0.7	71.5	27.5	1.0
CORS-108-R-2000	0.6	73.2	25.6	1.0
CORS-205-R-2000	0.8	60.7	38.4	0.1
SEAS-109-R-2000	1.0	68.8	30.2	0.4
SEAS-111-R-2000	0.5	74.4	25.1	0.3
SEAS-113-R-2000	0.2	74.1	25.6	0.9
SEAS-116-R-2000	0.2	74.4	25.3	0.6
SEAS-120-R-2000	0.0	95.7	4.3	0.0

Interpretation of Watershed Condition

- Watershed dominated by agricultural land uses; most sites have large amounts of agricultural land use in catchment. Nitrogen and phosphorous concentrations are also high.
- High embeddedness typical of Coastal Plain watershed; silt/sand substrate common.
- Most sites in forested stream corridors, although some less than 50 m wide
- Very little flow observed at Sites 116 and 120; Site 120 standing pools with little water during summer

Corsica River/Southeast Creek

Water Chemistry Information

Site	Closed pH	Specific Cond.	ANC (ueq/L)	CI (mg/L)	Nitrate-N (mg/L)	SO4 (mg/L)	P-P (mg/L)	TD-P (mg/L)	Ortho-P (mg/L)	Nitrite (mg/L)	Ammonia (mg/L)	TD-N (mg/L)	P-N (mg/L)	P-C (mg/L)	DOC (mg/L)	DO (mg/L)	Turbidity (NTUs)
CORS-102-R-2000	6.35	63.4	183.0	6.522	0.164	5.435	0.013	0.019	0.007	0.011	0.048	0.791	0.055	1.047	17.384	5.9	11
CORS-106-R-2000	6.93	177.9	555.5	12.922	3.753	20.459	0.016	0.036	0.011	0.028	0.050	4.400	0.116	0.957	8.985	5.6	8.5
CORS-107-R-2000	7.16	197.4	852.1	26.078	1.011	8.309	0.020	0.085	0.041	0.022	0.074	1.798	0.095	0.793	11.162	5.9	4.5
CORS-108-R-2000	7.43	225.7	839.0	23.879	2.762	13.567	0.007	0.045	0.027	0.000	0.006	3.372	0.053	0.529	7.185	6.8	4.3
CORS-205-R-2000	6.88	162.3	518.2	13.020	3.756	14.388	0.023	0.042	0.026	0.019	0.051	4.285	0.056	0.729	11.112	6.3	8.7
SEAS-109-R-2000	7.29	251.5	800.1	26.539	4.156	15.333	0.015	0.046	0.029	0.000	0.000	4.639	0.113	0.879	6.962	6.9	4.5
SEAS-111-R-2000	7.25	246.1	639.9	23.985	4.642	22.585	0.014	0.039	0.022	0.000	0.005	5.308	0.041	0.565	5.086	7.7	6.1
SEAS-113-R-2000	6.68	186.0	515.5	21.218	4.492	8.372	0.022	0.074	0.052	0.003	0.140	5.418	0.077	0.864	6.688	6.0	10.8
SEAS-116-R-2000	7.05	202.2	733.9	24.003	3.888	11.113	0.028	0.059	0.030	0.018	0.210	4.683	0.204	1.727	6.720	3.7	5.1
SEAS-120-R-2000	6.31	276.9	569.0	31.259	4.710	23.824	0.014	0.038	0.012	0.006	0.131	5.423	0.108	1.144	11.926	2.6	42

Physical Habitat Condition

Site	Riparian Buffer Width Left	Riparian Buffer Width Right	Adjacent Cover Left	Adjacent Cover Right	Instream Habitat Structure	Epifaunal Substrate	Velocity/Depth Diversity	Pool/Glide/Eddy Quality	Extent of Pools (m)	Riffle Run Quality	Extent of Riffles (m)	Embeddedness	Shading	Trash Rating	Maximum Depth (cm)
CORS-102-R-2000	50	50	OF	FR	10	8	8	9	43	12	37	40	80	18	44
CORS-106-R-2000	50	34	FR	CP	15	12	10	10	42	16	39	50	75	15	42
CORS-107-R-2000	32	50	PV	FR	11	10	11	8	72	11	11	50	65	17	38
CORS-108-R-2000	50	50	LN	OF	14	13	14	15	64	11	11	50	90	14	73
CORS-205-R-2000	50	50	FR	TG	15	13	8	14	75	16	11	100	25	17	65
SEAS-109-R-2000	50	50	FR	FR	14	13	9	8	66	7	13	15	95	10	37
SEAS-111-R-2000	50	50	LN	FR	7	6	8	9	60	13	20	100	90	11	40
SEAS-113-R-2000	50	50	FR	FR	6	5	9	11	75	0	0	100	95	18	54
SEAS-116-R-2000	30	50	CP	FR	8	6	11	12	63	14	12	100	85	19	71
SEAS-120-R-2000	12	15	CP	CP	1	1	2	2	19	0	0	100	85	10	7

Physical Habitat Modifications

Site	Buffer Breaks?	Surface Mine?	Landfill?	Channelization?	Erosion Severity Left	Erosion Severity Right	Bar Formation
CORS-102-R-2000	N	N	N	N	Severe	Severe	Moderate
CORS-106-R-2000	N	N	N	N	Mild	Mild	None
CORS-107-R-2000	N	N	N	N	Moderate	Moderate	Minor
CORS-108-R-2000	N	N	N	N	Mild	Mild	Minor
CORS-205-R-2000	N	N	N	N	None	Mild	None
SEAS-109-R-2000	N	N	N	N	Severe	Severe	Moderate
SEAS-111-R-2000	N	N	N	N	Moderate	Severe	Moderate
SEAS-113-R-2000	Y	N	N	Y	None	None	Minor
SEAS-116-R-2000	N	N	N	N	Mild	Mild	Minor
SEAS-120-R-2000	N	N	N	N	Mild	Mild	None

Corsica River/Southeast Creek

Fish Species Present

AMERICAN EEL
BLUEGILL
BROWN BULLHEAD
CREEK CHUBSUCKER
EASTERN MUDMINNOW
FALLFISH
GOLDEN SHINER
LARGEMOUTH BASS
LEAST BROOK LAMPREY
MARGINED MADTOM
PIRATE PERCH
PUMPKINSEED
REDBREAST SUNFISH
REDFIN PICKEREL
ROSYSIDE DACE
SWALLOWTAIL SHINER
TADPOLE MADTOM
TESSELLATED DARTER
WHITE SUCKER

Exotic Plants Present

JAPANESE HONEYSUCKLE
MULTIFLORA ROSE
THISTLE

Benthic Taxa Present

AMPHIPODA
ABLABESMYIA
ACENTRELLA
ACERPENNA
AEDES
AGABUS
AMELETUS
AMPHINEMURA
ANCYRONYX
ARGIA
BEZZIA
BOYERIA
BRILLIA
CERATOPOGONIDAE
CHIRONOMINI
CORIXIDAE
CRANGONYCTIDAE
CAECIDOTEA
CALOPTERYX
CERACLEA
CHEUMATOPSYCHE
CHIRONOMUS
CLINOTANYPUS
CLIOPERLA
CONCHAPELOPIA
CORYNONEURA
CRICOTOPUS
CRICOTOPUS/ORTHOCLADIUS
DOLICHOPODIDAE
DYTISCIDAE
DICRANOTA
DICROTENDIPES
DIPLECTRONA
DIPLOCLADIUS
DUBIRAPHIA
DUGESIA
ENCHYTRAEIDAE
EPHEMERELLA
EUKIEFFERIELLA
EURYLOPHELLA
GAMMARUS
GONIOBASIS
HEPTAGENIIDAE
HYDROBIIDAE
HELENIELLA
HELICHUS
HEXAGENIA
HYDROBIUS

HYDROCHARA
HYDROPORUS
IRONOQUIA
ISOPERLA
ISOTOMURUS
KRENOPELOPIA
LEPTOPHLEBIIDAE
LIMNEPHILIDAE
LEPTOPHLEBIA
LYPE
MACRONYCHUS
MENETUS
MEROPELOPIA
MICROPSECTRA
MICROTENDIPES
NAIDIDAE
NANOCLADIUS
NEOPHYLAX
NYCTIOPHYLAX
ORTHOCLADIINAE
PERLODIDAE
PARAMERINA
PARAMETRIOCNEMUS
PARATANYTARSUS
PARATENDIPES
PHYSELLA
PISIDIUM
POLYPEDILUM
POTTHASTIA
PRODIAMESA
PROGOMPHUS
PROSIMULIUM
PSEPHENUS
PSEUDOLIMNOPHILA
PYCNOPSYCHE
RHEOCRICOTOPUS
RHEOTANYTARSUS
SIMULIIDAE
SPHAERIIDAE
SIMULIUM
STEGOPTERNA
STEMPELLINELLA
STENACRON
STENELMIS
STENONEMA
STICTOCHIRONOMUS
SYNURELLA
TANYPODINAE
TUBIFICIDAE

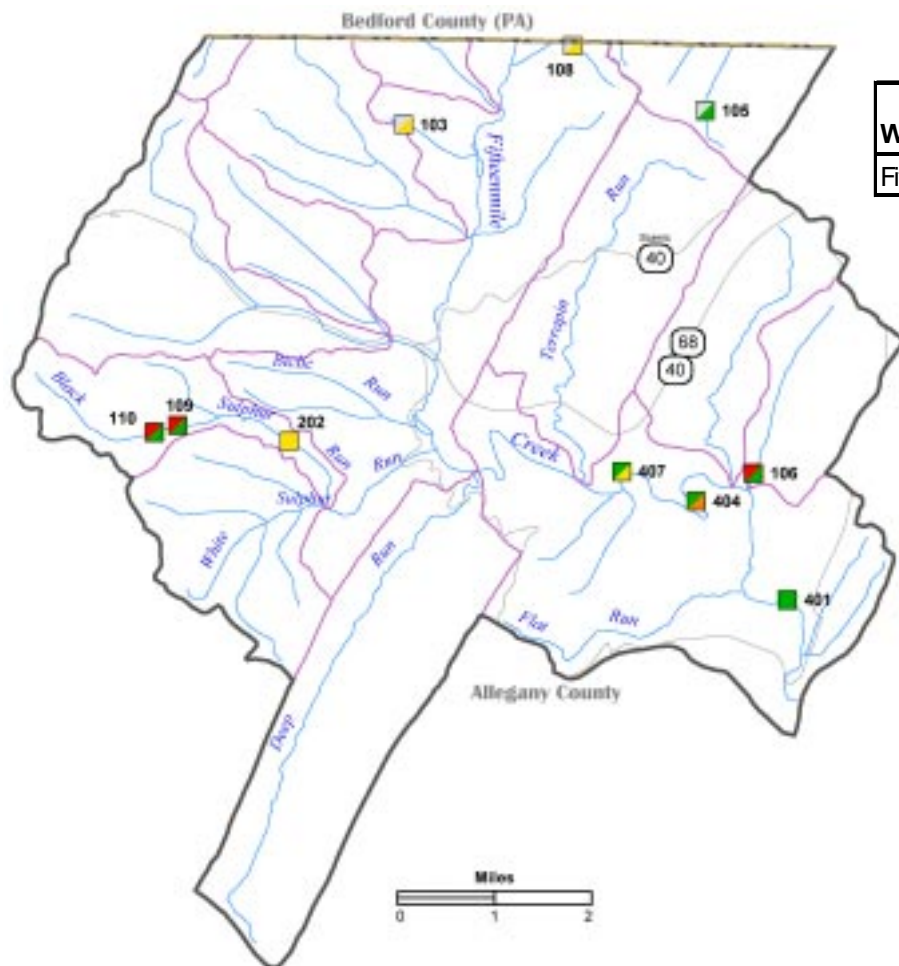
TANYTARSUS
THIENEMANNIELLA
TIPULA
TRIBELOS
TRISSOPELOPIA
XYLOTOPUS
ZAVRELIMYIA

Herpetofauna Present

BULLFROG
COMMON SNAPPING TURTLE
FIVE-LINED SKINK
FOWLER'S TOAD
GREEN FROG
NORTHERN TWO-LINED SALAMANDER
NORTHERN WATER SNAKE
PICKEREL FROG
SOUTHERN LEOPARD FROG
WOOD FROG

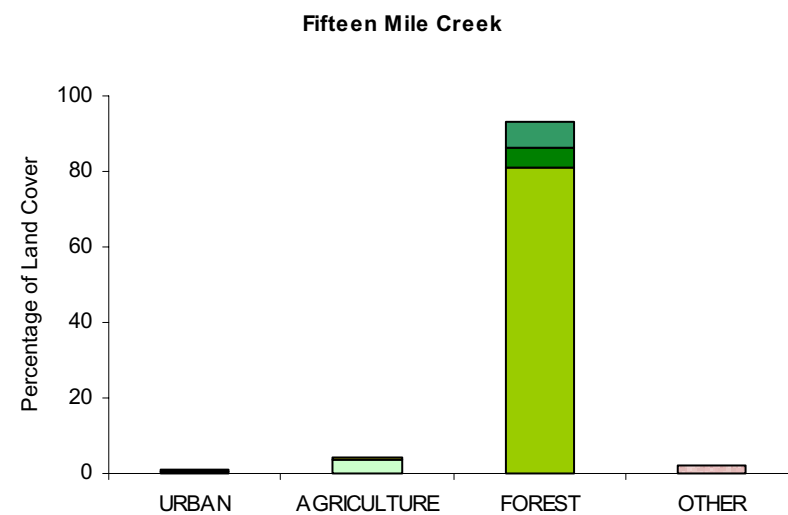
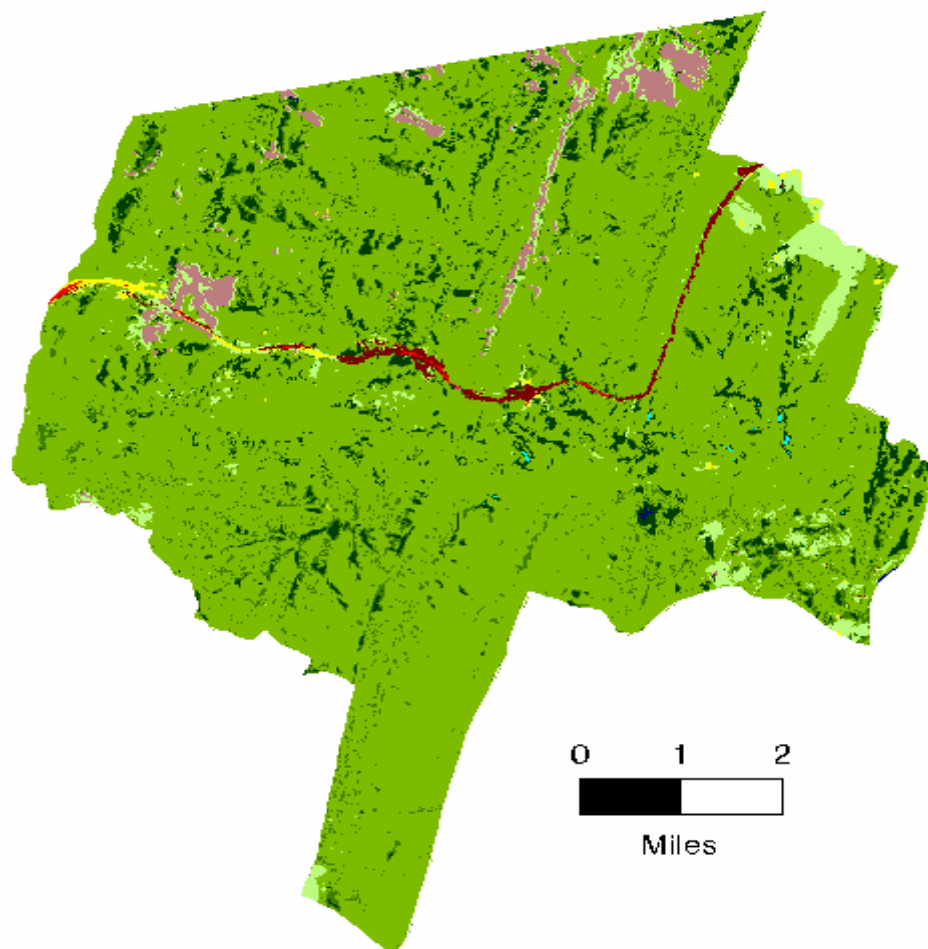


Fifteenmile Creek watershed MBSS 2000



Watershed	Total Land Area (acres)	Total Stream Miles
Fifteenmile Creek	33173	81.3

Fifteenmile Creek



Fifteenmile Creek

Site Information

Site	Stream Name	12-digit Subwatershed Code	8-digit Watershed	Basin	County	Date Sampled Spring	Date Sampled Summer	Order	Catchment Area (acres)
FIMI-103-R-2000	FIFTEENMILE CR UT1	021405110137	Fifteen Mile CR	UPPER POTOMAC RIVER	Allegany	03/16/00	07/31/00	1	51
FIMI-105-R-2000	SIDELING HILL CR UT1	021405110147	Fifteen Mile CR	UPPER POTOMAC RIVER	Allegany	03/16/00	08/10/00	1	118
FIMI-106-R-2000	SPRING LICK RUN	021405110142	Fifteen Mile CR	UPPER POTOMAC RIVER	Allegany	03/16/00	07/31/00	1	1285
FIMI-108-R-2000	FIFTEENMILE CR UT2	021405110137	Fifteen Mile CR	UPPER POTOMAC RIVER	Allegany	04/03/00	09/11/00	1	137
FIMI-109-R-2000	BLACK SULPHUR RUN	021405110138	Fifteen Mile CR	UPPER POTOMAC RIVER	Allegany	03/16/00	07/31/00	1	760
FIMI-110-R-2000	BLACK SULPHUR RUN	021405110138	Fifteen Mile CR	UPPER POTOMAC RIVER	Allegany	03/16/00	07/31/00	1	635
FIMI-202-R-2000	BLACK SULPHUR RUN	021405110138	Fifteen Mile CR	UPPER POTOMAC RIVER	Allegany	03/16/00	08/02/00	2	1377
FIMI-401-R-2000	FIFTEENMILE CR	021405110135	Fifteen Mile CR	UPPER POTOMAC RIVER	Allegany	03/16/00	08/17/00	4	39661
FIMI-404-R-2000	FIFTEENMILE CR	021405110135	Fifteen Mile CR	UPPER POTOMAC RIVER	Allegany	04/03/00	09/12/00	4	33949
FIMI-407-R-2000	FIFTEENMILE CR	021405110135	Fifteen Mile CR	UPPER POTOMAC RIVER	Allegany	04/03/00	08/22/00	4	33583

Indicator Information

Site	FIBI	BIBI	PHI	Brook Trout Present	Black Water Stream
FIMI-103-R-2000	NS	3.44	NS	NS	NS
FIMI-105-R-2000	NR	4.11	2.20	0	0
FIMI-106-R-2000	1.29	4.11	58.46	0	0
FIMI-108-R-2000	NS	3.67	NS	NS	NS
FIMI-109-R-2000	1.57	4.11	24.38	0	0
FIMI-110-R-2000	1.00	4.78	16.48	0	0
FIMI-202-R-2000	3.29	3.89	22.19	0	0
FIMI-401-R-2000	4.71	4.11	79.66	0	0
FIMI-404-R-2000	4.43	2.56	70.98	0	0
FIMI-407-R-2000	4.71	3.44	67.04	0	0

Catchment Land Use Information

Site	Percent Urban	Percent Agriculture	Percent Forest	Percent Other
FIMI-103-R-2000	0.0	0.0	100.0	0.0
FIMI-105-R-2000	0.0	1.3	77.2	21.5
FIMI-106-R-2000	0.0	22.8	77.2	0.0
FIMI-108-R-2000	0.0	6.7	70.8	24.1
FIMI-109-R-2000	0.0	4.4	95.1	0.5
FIMI-110-R-2000	0.0	2.5	97.0	0.5
FIMI-202-R-2000	0.0	2.6	97.1	0.3
FIMI-401-R-2000	0.7	4.2	92.3	2.9
FIMI-404-R-2000	0.6	3.2	92.9	3.4
FIMI-407-R-2000	0.6	3.3	92.8	3.4

Interpretation of Watershed Condition

- Extensive forest throughout most of watershed
- ANC values are low at most sites
- Most sites are located in small streams in forested watersheds, but fish numbers are low. Typical of Ridge and Valley streams, where nearly all stream go dry every year; even fourth order streams become standing pools in summer during most years. Low physical habitat scores mainly due to small streams with little water. Several streams dry in summer.
- Site 110 very small stream; juvenile creek chub and blacknose dace < 30 mm present, no adults
- Cows have access to the stream at Site 105, where there is no riparian buffer.

Fifteenmile Creek

Water Chemistry Information

Site	Closed pH	Specific Cond.	ANC (ueq/L)	Cl (mg/L)	Nitrate-N (mg/L)	SO4 (mg/L)	P-P (mg/L)	TD-P (mg/L)	Ortho-P (mg/L)	Nitrite (mg/L)	Ammonia (mg/L)	TD-N (mg/L)	P-N (mg/L)	P-C (mg/L)	DOC (mg/L)	DO (mg/L)	Turbidity (NTUs)
FIMI-103-R-2000	6.48	34.3	69.0	0.814	0.095	7.828	0.000	0.003	0.001	0.000	0.000	0.170	0.015	0.156	1.713	NS	NS
FIMI-105-R-2000	6.58	46.2	85.4	1.337	0.145	11.058	0.001	0.007	0.002	0.000	0.002	0.325	0.021	0.230	1.273	5.5	2
FIMI-106-R-2000	7.02	75.7	117.1	5.295	0.969	13.349	0.000	0.008	0.001	0.000	0.000	1.240	0.010	0.116	1.795	8.1	1.6
FIMI-108-R-2000	6.91	74.3	150.7	8.719	0.348	7.919	0.001	0.002	0.001	0.000	0.012	0.445	0.026	0.256	1.769	NS	NS
FIMI-109-R-2000	7.01	52.6	145.4	1.964	0.393	9.667	0.000	0.007	0.001	0.000	0.000	0.407	0.016	0.114	1.314	6.6	3.2
FIMI-110-R-2000	6.96	51.6	159.5	1.378	0.437	9.751	0.000	0.005	0.000	0.000	0.000	0.551	0.012	0.099	1.151	8.0	3
FIMI-202-R-2000	7.03	52.9	151.8	2.191	0.259	9.994	0.000	0.006	0.001	0.000	0.000	0.341	0.010	0.074	1.300	7.3	0.6
FIMI-401-R-2000	7.15	81.0	195.4	8.334	0.233	11.613	0.000	0.006	0.000	0.000	0.000	0.312	0.012	0.095	1.473	6.6	1.8
FIMI-404-R-2000	7.29	85.4	255.9	8.556	0.118	11.672	0.000	0.002	0.000	0.000	0.000	0.188	0.015	0.101	1.319	6.2	1.8
FIMI-407-R-2000	7.40	81.6	254.5	8.309	0.122	11.725	0.000	0.004	0.000	0.000	0.013	0.194	0.010	0.103	1.331	7.7	1

Physical Habitat Condition

Site	Riparian Buffer Width Left	Riparian Buffer Width Right	Adjacent Cover Left	Adjacent Cover Right	Instream Habitat Structure	Epifaunal Substrate	Velocity/ Depth Diversity	Pool/Glide/ Eddy Quality	Extent of Pools (m)	Riffle Run Quality	Extent of Riffles (m)	Embedded-ness	Shading	Trash Rating	Maximum Depth (cm)
FIMI-103-R-2000	50	50	FR	FR	NS	NS	NS	NS	NS	NS	NS	NS	NS	20	NS
FIMI-105-R-2000	0	0	PA	PA	6	3	6	6	60	3	15	60	45	3	20
FIMI-106-R-2000	50	28	FR	DI	12	12	10	9	65	7	12	10	98	20	30
FIMI-108-R-2000	50	50	FR	FR	NS	NS	NS	NS	NS	NS	NS	NS	NS	18	NS
FIMI-109-R-2000	50	50	FR	FR	11	17	6	10	70	6	10	10	92	20	38
FIMI-110-R-2000	50	50	FR	FR	10	14	5	8	50	7	25	10	95	20	16
FIMI-202-R-2000	50	50	FR	FR	13	14	6	8	75	6	5	10	80	20	39
FIMI-401-R-2000	50	50	FR	FR	17	17	14	14	45	16	45	10	40	18	71
FIMI-404-R-2000	50	50	FR	FR	17	15	14	15	50	13	30	15	40	17	59
FIMI-407-R-2000	50	50	FR	FR	16	18	15	15	75	10	25	10	65	20	89

Physical Habitat Modifications

Site	Buffer Breaks?	Surface Mine?	Landfill?	Channelization?	Erosion Severity Left	Erosion Severity Right	Bar Formation
FIMI-103-R-2000	N	N	N	N	NS	NS	NS
FIMI-105-R-2000	Y	N	N	N	Moderate	Moderate	Moderate
FIMI-106-R-2000	Y	N	N	N	None	None	Minor
FIMI-108-R-2000	N	N	N	N	NS	NS	NS
FIMI-109-R-2000	N	N	N	N	None	None	Minor
FIMI-110-R-2000	N	N	N	N	Mild	None	Minor
FIMI-202-R-2000	N	N	N	N	None	None	Moderate
FIMI-401-R-2000	N	N	N	N	None	None	Minor
FIMI-404-R-2000	N	N	N	N	None	None	Moderate
FIMI-407-R-2000	N	N	N	N	None	Mild	Minor

Fifteenmile Creek

Fish Species Present

BLACKNOSE DACE
BLUEGILL
BLUNTNOST MINNOW
CENTRAL STONEROLLER
CHAIN PICKEREL
COMMON SHINER
CREEK CHUB
FALLFISH
FANTAIL DARTER
GREEN SUNFISH
GREENSIDE DARTER
LONGEAR SUNFISH
LONGLNOSE DACE
MARGINED MADTOM
MOTTLED SCULPIN
NORTHERN HOGSUCKER
POTOMAC SCULPIN
PUMPKINSEED
RAINBOW DARTER
REDBREAST SUNFISH
RIVER CHUB
ROCK BASS
ROSYFACE SHINER
SMALLMOUTH BASS
SPOTFIN SHINER
WHITE SUCKER
YELLOW BULLHEAD

Exotic Plants Present

MULTIFLORA ROSE
THISTLE

Benthic Taxa Present

ACENTRELLA
ACRONEURIA
AMELETUS
AMPHINEMURA
BAETIDAE
BRACHYCENTRIDAE
CAMBARIDAE
CHLOROPERLIDAE
COLLEMBOLA
CAECIDOTEA
CAENIS
CAMBARUS
CERATOPOGON
CHRYSOPTERUS
CINYGOMULA
CLINOCERA
CLIOPERLA
CNEPHIA
CONCHAPELOPIA
CORYNONEURA
CURA
DIPLECTRONA
DRUNELLA
EPEORUS
EPHEMERELLA
EUKIEFFERIELLA
EURYLOPHELLA
HEPTAGENIIDAE
HELENIELLA
HELICHRUS
HETEROTRISOCLADIUS
HEXATOMA
ISOPERLA
KRENOPELOPIA
LEPTOPHLEBIIDAE
LEUCTRIDAE
LIMNNEPHILIDAE
LUMBRICULIDAE
LEPIDOSTOMA
LEUCTRA

MEROPELOPIA
MICROPSECTRA
NAIDIDAE
NEMOURIDAE
NEOPHYLAX
ORTHOCLADIINAE
OEMOPTERYX
OPTIOSERVUS
ORCONECTES
*PERLIDAE
PERLODIDAE
PHILOPOTAMIDAE
PARALEPTOPHLEBIA
PARAMETRIOCNEMUS
PROSIMULIUM
PSECTROTANYPUS
PSEUDOLIMNOPHILA
RHYACOPHILA
SERRATELLA
SIMULIUM
STEGOPTERNA
STEMPELLINELLA
STENELMIS
STROPHOPTERYX
SWELTSIA
TAENIOPTERYGIDAE
TANYPODINAE
TANYTARSINI
TIPULIDAE
TAENIOPTERYX
TANYTARSUS
TIPULA
TVETENIA
WORMALDIA
ZAVRELIMYIA

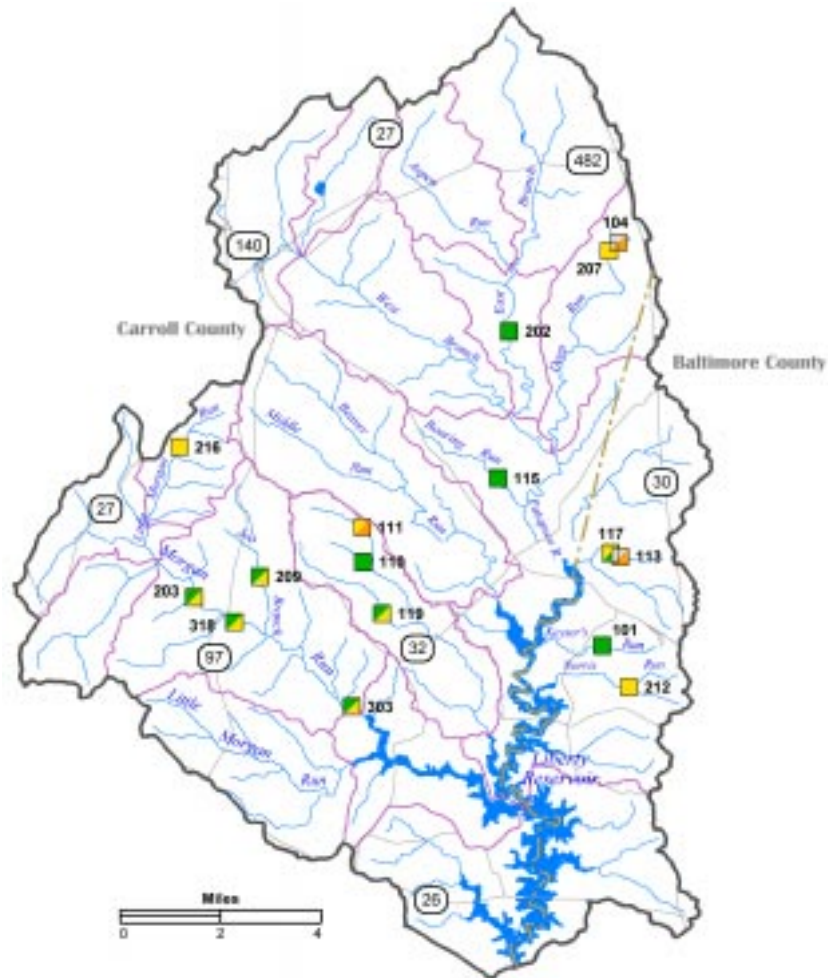
Herpetofauna Present

BULLFROG
COMMON SNAPPING TURTLE
EASTERN BOX TURTLE
FOWLER'S TOAD
GREEN FROG
LONGTAIL SALAMANDER
NORTHERN DUSKY SALAMANDER
NORTHERN TWO-LINED SALAMANDER
NORTHERN WATER SNAKE
RED SALAMANDER
WOOD FROG
WOOD TURTLE

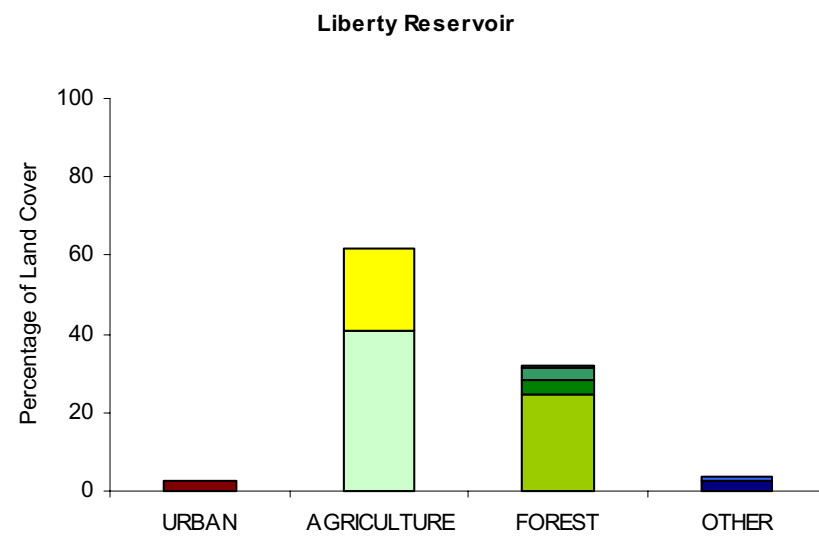
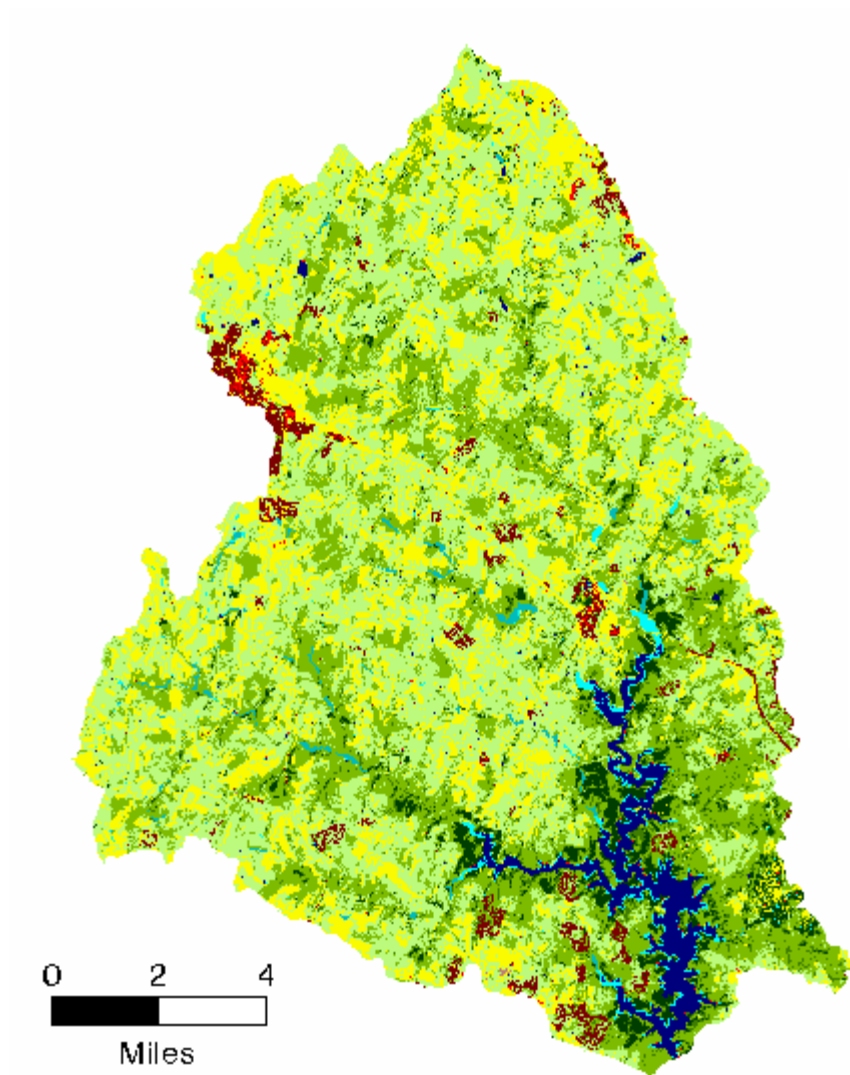


**Liberty Reservoir watershed
MBSS 2000**

Liberty Reservoir



Watershed	Total Land Area (acres)	Total Stream Miles
Liberty Reservoir	104801	184



Liberty Reservoir

Site Information

Site	Stream Name	12-digit Subwatershed Code	8-digit Watershed	Basin	County	Date Sampled Spring	Date Sampled Summer	Order	Catchment Area (acres)
LIBE-101-R-2000	KEYSERS RUN	021309071048	Liberty Reservoir	PATAPSCO RIVER	Baltimore	03/06/00	06/21/00	1	398
LIBE-104-R-2000	DEEP RUN UT1	021309071058	Liberty Reservoir	PATAPSCO RIVER	Carroll	03/06/00	06/20/00	1	161
LIBE-110-R-2000	MIDDLE RUN	021309071056	Liberty Reservoir	PATAPSCO RIVER	Carroll	03/07/00	06/19/00	1	335
LIBE-111-R-2000	MIDDLE RUN UT2	021309071056	Liberty Reservoir	PATAPSCO RIVER	Carroll	03/02/00	06/13/00	1	471
LIBE-113-R-2000	LIBERTY RESERVOIR UT1 UT1	021309071048	Liberty Reservoir	PATAPSCO RIVER	Baltimore	03/01/00	06/14/00	1	292
LIBE-115-R-2000	ROARING RUN	021309071048	Liberty Reservoir	PATAPSCO RIVER	Carroll	03/06/00	06/14/00	1	1183
LIBE-117-R-2000	LIBERTY RESERVOIR UT1 UT1	021309071048	Liberty Reservoir	PATAPSCO RIVER	Baltimore	03/01/00	06/14/00	1	339
LIBE-119-R-2000	MIDDLE RUN UT1	021309071056	Liberty Reservoir	PATAPSCO RIVER	Carroll	03/02/00	06/15/00	1	1027
LIBE-202-R-2000	EAST BR PATAPSCO	021309071052	Liberty Reservoir	PATAPSCO RIVER	Carroll	03/06/00	07/17/00	2	12257
LIBE-203-R-2000	MORGAN RUN	021309071050	Liberty Reservoir	PATAPSCO RIVER	Carroll	03/02/00	06/12/00	2	9686
LIBE-207-R-2000	DEEP RUN	021309071058	Liberty Reservoir	PATAPSCO RIVER	Carroll	03/06/00	06/20/00	2	538
LIBE-209-R-2000	JOE BR	021309071050	Liberty Reservoir	PATAPSCO RIVER	Carroll	03/01/00	06/21/00	2	1675
LIBE-212-R-2000	NORRIS RUN	021309071048	Liberty Reservoir	PATAPSCO RIVER	Baltimore	03/06/00	06/19/00	2	850
LIBE-216-R-2000	LITTLE MORGAN RUN	021309071055	Liberty Reservoir	PATAPSCO RIVER	Carroll	03/07/00	06/15/00	2	843
LIBE-303-R-2000	MORGAN RUN	021309071050	Liberty Reservoir	PATAPSCO RIVER	Carroll	03/01/00	06/12/00	3	18000
LIBE-318-R-2000	MORGAN RUN	021309071050	Liberty Reservoir	PATAPSCO RIVER	Carroll	03/02/00	07/13/00	3	12021

Indicator Information

Site	FIBI	BIBI	PHI	Brook Trout Present	Black Water Stream
LIBE-101-R-2000	4.11	4.33	70.13	0	0
LIBE-104-R-2000	NR	2.78	34.60	0	0
LIBE-110-R-2000	4.11	4.56	47.29	0	0
LIBE-111-R-2000	3.89	2.78	68.82	0	0
LIBE-113-R-2000	NR	2.78	83.63	0	0
LIBE-115-R-2000	4.11	4.11	82.12	0	0
LIBE-117-R-2000	3.00	4.11	96.19	0	0
LIBE-119-R-2000	4.33	3.89	75.01	0	0
LIBE-202-R-2000	4.11	4.11	98.44	0	0
LIBE-203-R-2000	4.11	3.44	67.76	0	0
LIBE-207-R-2000	3.67	3.44	64.27	0	0
LIBE-209-R-2000	4.11	3.44	88.46	0	0
LIBE-212-R-2000	3.89	3.00	99.41	1	0
LIBE-216-R-2000	3.89	3.89	99.79	0	0
LIBE-303-R-2000	4.33	3.44	95.62	0	0
LIBE-318-R-2000	4.11	3.44	86.15	0	0

Catchment Land Use Information

Site	Percent Urban	Percent Agriculture	Percent Forest	Percent Other
LIBE-101-R-2000	5.6	59.3	35.0	0.2
LIBE-104-R-2000	11.7	83.1	5.0	10.8
LIBE-110-R-2000	0.0	60.4	39.6	0.4
LIBE-111-R-2000	0.1	95.3	3.8	0.9
LIBE-113-R-2000	0.1	32.4	67.3	3.1
LIBE-115-R-2000	6.2	70.3	23.5	0.1
LIBE-117-R-2000	0.3	28.0	71.5	2.8
LIBE-119-R-2000	0.9	87.5	11.3	0.5
LIBE-202-R-2000	1.7	79.4	18.7	0.4
LIBE-203-R-2000	0.6	77.0	22.0	0.4
LIBE-207-R-2000	10.5	79.9	9.6	3.0
LIBE-209-R-2000	0.1	64.2	35.7	0.1
LIBE-212-R-2000	8.8	50.0	41.2	0.0
LIBE-216-R-2000	2.6	74.4	21.5	1.8
LIBE-303-R-2000	0.7	69.0	30.0	0.4
LIBE-318-R-2000	0.7	75.0	23.9	0.6

Interpretation of Watershed Condition

- IBI scores generally good to fair
- Agricultural land use common and impacts noted at several sites. High nitrogen concentrations at many sites; also some high phosphorous. Cows have access to stream at Site 110.
- There is logging in the riparian area at Site 216; logging road crosses stream
- Impoundments at or near several sites

- Brown and rainbow trout stocked at several locations

Liberty Reservoir

Water Chemistry Information

Site	Closed pH	Specific Cond.	ANC (ueq/L)	Cl (mg/L)	Nitrate-N (mg/L)	SO4 (mg/L)	P-P (mg/L)	TD-P (mg/L)	Ortho-P (mg/L)	Nitrite (mg/L)	Ammonia (mg/L)	TD-N (mg/L)	P-N (mg/L)	P-C (mg/L)	DOC (mg/L)	DO (mg/L)	Turbidity (NTUs)
LIBE-101-R-2000	7.09	206.1	661.1	30.557	3.096	5.210	0.002	0.009	0.004	0.009	0.021	3.352	0.014	0.062	0.952	8.6	2.3
LIBE-104-R-2000	7.10	424.5	446.8	73.944	2.512	24.191	0.014	0.009	0.003	0.056	0.441	3.272	0.329	1.888	2.379	7.2	4.3
LIBE-110-R-2000	6.82	99.6	228.9	12.642	2.626	2.758	0.002	0.004	0.003	0.009	0.014	2.743	0.008	0.123	1.494	8.4	4.2
LIBE-111-R-2000	7.05	122.1	301.4	13.195	4.074	3.530	0.004	0.020	0.011	0.021	0.066	4.332	0.031	0.407	1.055	8.1	13.4
LIBE-113-R-2000	7.11	130.0	349.8	18.760	1.051	5.865	0.002	0.008	0.005	0.031	0.026	1.359	0.028	0.376	2.128	7.8	2.3
LIBE-115-R-2000	7.28	220.7	342.0	41.152	4.126	5.318	0.001	0.008	0.003	0.011	0.018	4.401	0.001	0.047	0.867	9.4	1.8
LIBE-117-R-2000	6.85	164.6	447.8	24.834	1.049	7.573	0.002	0.008	0.005	0.024	0.013	1.281	0.032	0.349	1.535	7.8	2.3
LIBE-119-R-2000	7.14	170.5	318.0	25.040	4.902	4.139	0.005	0.022	0.012	0.022	0.041	5.392	0.092	0.812	1.352	8.5	3.9
LIBE-202-R-2000	7.97	174.2	411.1	21.459	4.918	5.948	0.002	0.008	0.003	0.015	0.015	5.214	0.015	0.104	1.173	8.1	4.3
LIBE-203-R-2000	7.41	153.0	451.2	17.149	3.749	5.832	0.002	0.011	0.005	0.013	0.007	4.172	0.012	0.151	1.304	9.1	6.7
LIBE-207-R-2000	6.82	293.2	341.9	50.392	5.793	14.537	0.006	0.008	0.003	0.030	0.093	5.967	0.118	0.623	2.039	8.5	3.5
LIBE-209-R-2000	7.20	174.6	290.8	30.153	2.856	6.101	0.001	0.009	0.005	0.009	0.000	2.973	0.014	0.314	1.291	9.0	2.2
LIBE-212-R-2000	7.32	205.9	660.4	30.004	1.864	8.976	0.001	0.010	0.005	0.010	0.014	2.054	0.005	0.048	1.259	8.8	1.7
LIBE-216-R-2000	7.49	200.7	637.7	25.439	4.454	5.744	0.002	0.008	0.003	0.021	0.043	4.729	0.006	0.161	1.547	8.4	9.5
LIBE-303-R-2000	7.41	153.8	395.7	20.803	2.979	6.011	0.001	0.008	0.005	0.010	0.003	3.009	0.017	0.232	1.139	8.1	7.8
LIBE-318-R-2000	7.47	155.2	429.9	19.289	3.555	5.619	0.001	0.008	0.005	0.012	0.003	3.662	0.020	0.153	0.879	8.8	6.3

Physical Habitat Condition

Site	Riparian Buffer Width Left	Riparian Buffer Width Right	Adjacent Cover Left	Adjacent Cover Right	Instream Habitat Structure	Epifaunal Substrate	Velocity/Depth Diversity	Pool/Glide/Eddy Quality	Extent of Pools (m)	Riffle Run Quality	Extent of Riffles (m)	Embedded-ness	Shading	Trash Rating	Maximum Depth (cm)
LIBE-101-R-2000	1	1	PA	PA	15	17	8	10	17	14	60	15	72	19	42
LIBE-104-R-2000	0	0	PA	PA	9	10	10	15	15	12	65	13	40	18	32
LIBE-110-R-2000	15	15	CP	OR	13	14	7	8	20	8	55	30	90	18	32
LIBE-111-R-2000	20	50	PV	HO	15	17	11	10	30	11	60	20	98	10	41
LIBE-113-R-2000	50	50	HO	FR	16	15	8	8	15	15	60	15	95	5	32
LIBE-115-R-2000	1	50	PV	FR	18	18	12	8	30	16	73	7	82	15	31
LIBE-117-R-2000	50	50	HO	FR	15	17	8	8	20	8	55	15	99	14	26
LIBE-119-R-2000	4	40	CP	CP	18	18	10	10	30	11	45	15	90	19	30
LIBE-202-R-2000	50	15	TG	PA	18	18	18	18	50	17	40	17	77	16	121
LIBE-203-R-2000	50	50	FR	FR	15	16	9	10	43	17	55	34	36	19	36
LIBE-207-R-2000	50	40	PA	PA	14	16	12	9	35	12	40	20	90	11	97
LIBE-209-R-2000	50	25	OF	PV	15	17	11	12	35	13	45	22	85	17	56
LIBE-212-R-2000	50	50	FR	FR	19	17	16	15	50	11	30	20	90	17	87
LIBE-216-R-2000	50	50	LO	LO	18	17	10	8	16	16	61	9	73	18	49
LIBE-303-R-2000	50	50	FR	FR	17	17	17	16	50	17	70	30	75	18	67
LIBE-318-R-2000	50	50	FR	FR	17	16	17	18	65	18	30	39	38	14	163

Liberty Reservoir

Physical Habitat Modifications

Site	Buffer Breaks?	Surface Mine?	Landfill?	Channelization?	Erosion Severity Left	Erosion Severity Right	Bar Formation
LIBE-101-R-2000	Y	N	N	N	Moderate	Moderate	Moderate
LIBE-104-R-2000	N	N	N	N	None	None	Minor
LIBE-110-R-2000	N	N	N	N	Moderate	Mild	Minor
LIBE-111-R-2000	N	N	N	Y	Severe	Severe	Moderate
LIBE-113-R-2000	N	N	N	N	Moderate	Moderate	None
LIBE-115-R-2000	N	N	N	N	None	None	Minor
LIBE-117-R-2000	N	N	N	Y	Moderate	Moderate	None
LIBE-119-R-2000	N	N	N	N	Moderate	Moderate	Moderate
LIBE-202-R-2000	N	N	N	N	Moderate	Mild	Minor
LIBE-203-R-2000	N	N	N	N	None	Mild	Severe
LIBE-207-R-2000	N	N	N	N	Moderate	Moderate	Minor
LIBE-209-R-2000	N	N	N	N	Moderate	Moderate	Moderate
LIBE-212-R-2000	N	N	N	N	Moderate	Moderate	Moderate
LIBE-216-R-2000	Y	N	N	N	Moderate	Moderate	Moderate
LIBE-303-R-2000	N	N	N	N	Mild	Mild	Moderate
LIBE-318-R-2000	N	N	N	N	Severe	Moderate	Moderate

Liberty Reservoir

Fish Species Present

BLACKNOSE DACE
BLUEGILL
BLUNTNOSE MINNOW
BROOK TROUT
BROWN TROUT
CENTRAL STONEROLLER
CHANNEL CATFISH
COMMON SHINER
CREEK CHUB
CUTLIPS MINNOW
GLASSY DARTER
GREEN SUNFISH
LARGEMOUTH BASS
LONGNOSE DACE
MARGINED MADTOM
MOTTLED SCULPIN
NORTHERN HOGSUCKER
PUMPKINSEED
RAINBOW TROUT
RIVER CHUB
ROSYSIDE DACE
SMALLMOUTH BASS
SPOTTAIL SHINER
TESSELLATED DARTER
WHITE SUCKER
YELLOW BULLHEAD

Exotic Plants Present

JAPANESE HONEYSUCKLE
MICROSTEGIUM
THISTLE

Benthic Taxa Present

ACRONEURIA
AMELETUS
AMPHINEMURA
ANCHYTARSUS
ANTOCHA
BAETIDAE
BAETIS
BRILLIA
CERATOPOGONIDAE
CHLOROPERLIDAE
CERATOPOGON
CHELIFERA
CHEUMATOPSYCHE
CHIMARRA
CHRYSOPTERUS
CLINOCERA
CONCHAPELOPIA
CORYDALUS
CORYNONEURA
CRICOTOPUS
CRICOTOPUS/ORTHOCLADIUS
CRYPTOCHIRONOMUS
CURA
DIAMESINAE
DIAMESA
DICRANOTA
DICROTENDIPES
DINEUTUS
DIPLECTRONA
DIPLOCLADIUS
DOLOPHILODES
DRUNELLA
DUBIRAPHIA
ELMIDAE
EMPIDIDAE
EPHEMERELLIDAE
EPHEMERELLA
EUKIEFFERIELLA
EURYLOPHELLA
GORDIIDAE
GLOSSOSOMA
GLYPTOTENDIPES
HELENIELLA
HEMERODROMIA
HEXATOMA
HYDROPSYCHE
HYDROPTILA
ISONYCHIA
KRENOPELOPIA
LEPTOPHLEBIIDAE

LEUCTRIDAE
LUMBRICULIDAE
LEUCTRA
LYPE
MEROPELOPIA
MICROPSECTRA
MICROTENDIPES
NAIDIDAE
NEMOURIDAE
NANOCLADIUS
NEOPHYLAX
NIGRONIA
ORTHOCLADIINAE
OEMOPTERYX
OPTIOSERVUS
ORMOSIA
OULIMNIUS
PERLODIDAE
PARACAPNIA
PARACHAETOCLADIUS
PARAKIEFFERIELLA
PARALEPTOPHLEBIA
PARAMETRIOCNEMUS
PHYSELLA
POLYPEDILUM
PROBEZZIA
PROSIMULIUM
PROSTOIA
PROSTOMA
PSEUDORTHOCLADIUS
PYCNOPSYCHE
RHEOTANYTARSUS
RHYACOPHILA
SIMULIIDAE
SPHAERIIDAE
SERRATELLA
SIMULIUM
SPHAERIUM
STEGOPTERNA
STENELMIS
STENONEMA
STILOCLADIUS
STROPHOPTERYX
SYMPOTTHASTIA
TANYTARSINI
TUBIFICIDAE
TANYTARSUS
THIENEMANNIELLA
TIPULA
TRISSOPELOPIA
TVETENIA

ZAVRELIMYIA

Herpetofauna Present

AMERICAN TOAD
BULLFROG
COMMON SNAPPING TURTLE
EASTERN BOX TURTLE
EASTERN MUD SALAMANDER
GREEN FROG
LONGTAIL SALAMANDER
NORTHERN DUSKY SALAMANDER
NORTHERN TWO-LINED SALAMANDER
NORTHERN WATER SNAKE
PICKEREL FROG
RED SALAMANDER

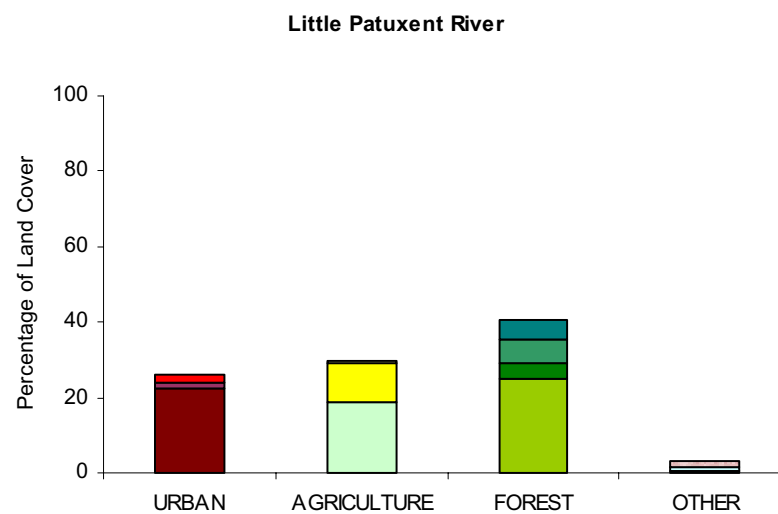
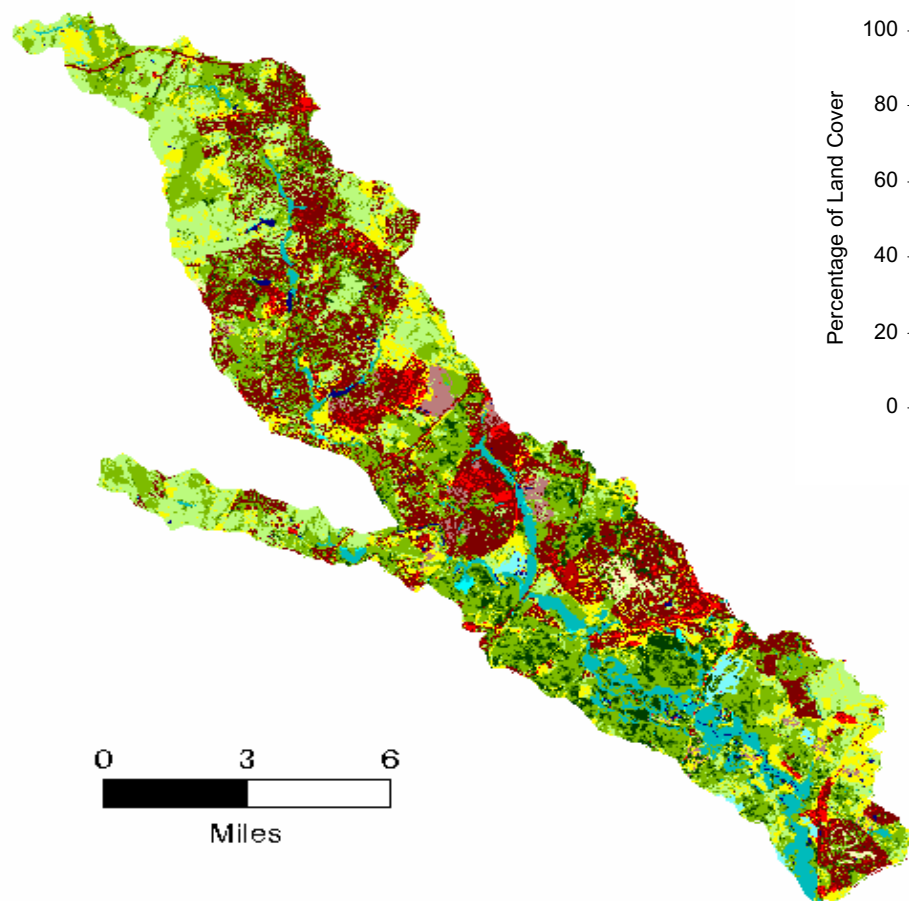


**Little Patuxent River
watershed
MBSS 2000**

Little Patuxent River



Watershed	Total Land Area (acres)	Total Stream Miles
Little Patuxent River	66214	149.8



Little Patuxent River

Site Information

Site	Stream Name	12-digit Subwatershed Code	8-digit Watershed	Basin	County	Date Sampled Spring	Date Sampled Summer	Order	Catchment Area (acres)
LPAX-109-R-2000	LITTLE PATUXENT R UT3	021311050957	Little Patuxent River	PATUXENT RIVER	Howard	03/13/00	07/07/00	1	404
LPAX-112-R-2000	HAMMOND BR	021311050950	Little Patuxent River	PATUXENT RIVER	Howard	03/15/00	07/18/00	1	2091
LPAX-113-R-2000	HAMMOND BR	021311050950	Little Patuxent River	PATUXENT RIVER	Howard	03/15/00	07/05/00	1	4226
LPAX-115-R-2000	LITTLE PATUXENT R UT4	021311050957	Little Patuxent River	PATUXENT RIVER	Howard	03/13/00	07/07/00	1	1053
LPAX-116-R-2000	LITTLE PATUXENT R UT1	021311050954	Little Patuxent River	PATUXENT RIVER	Howard	03/20/00	07/10/00	1	1198
LPAX-118-R-2000	LITTLE PATUXENT R UT2	021311050947	Little Patuxent River	PATUXENT RIVER	Anne Arundel	04/03/00	07/11/00	1	172
LPAX-203-R-2000	TOWSERS BR	021311050957	Little Patuxent River	PATUXENT RIVER	Anne Arundel	03/16/00	07/11/00	2	3021
LPAX-204-R-2000	LITTLE PATUXENT R	021311050947	Little Patuxent River	PATUXENT RIVER	Howard	03/15/00	07/05/00	2	7174
LPAX-206-R-2000	TOWSERS BR	021311050957	Little Patuxent River	PATUXENT RIVER	Anne Arundel	03/16/00	07/12/00	2	2789
LPAX-217-R-2000	LITTLE PATUXENT R	021311050954	Little Patuxent River	PATUXENT RIVER	Howard	03/13/00	07/05/00	2	4028
LPAX-311-R-2000	LITTLE PATUXENT R	021311050946	Little Patuxent River	PATUXENT RIVER	Howard	03/16/00	07/11/00	3	19696
LPAX-401-R-2000	LITTLE PATUXENT R	021311050948	Little Patuxent River	PATUXENT RIVER	Anne Arundel	03/16/00	09/18/00	4	93828
LPAX-408-R-2000	LITTLE PATUXENT R	021311050948	Little Patuxent River	PATUXENT RIVER	Anne Arundel	04/03/00	09/18/00	4	83759

Indicator Information

Site	FIBI	BIBI	PHI	Brook Trout Present	Black Water Stream
LPAX-109-R-2000	2.33	4.11	83.35	0	0
LPAX-112-R-2000	3.22	3.89	86.72	0	0
LPAX-113-R-2000	4.33	3.00	99.89	0	0
LPAX-115-R-2000	3.67	3.44	86.39	0	0
LPAX-116-R-2000	3.00	2.33	98.76	0	0
LPAX-118-R-2000	NR	2.11	14.09	0	0
LPAX-203-R-2000	3.25	1.29	83.87	0	0
LPAX-204-R-2000	2.78	4.33	54.44	0	0
LPAX-206-R-2000	4.25	1.86	79.07	0	0
LPAX-217-R-2000	3.22	3.67	98.59	0	0
LPAX-311-R-2000	2.78	2.78	54.44	0	0
LPAX-401-R-2000	4.25	1.57	99.48	0	0
LPAX-408-R-2000	4.75	1.86	96.29	0	0

Catchment Land Use Information

Site	Percent Urban	Percent Agriculture	Percent Forest	Percent Other
LPAX-109-R-2000	0.1	77.4	22.3	0.6
LPAX-112-R-2000	5.7	60.1	34.2	0.2
LPAX-113-R-2000	10.5	50.2	39.1	0.5
LPAX-115-R-2000	1.2	60.3	38.3	0.4
LPAX-116-R-2000	41.9	17.0	39.1	2.3
LPAX-118-R-2000	56.9	9.3	33.9	0.0
LPAX-203-R-2000	23.2	44.3	29.7	3.0
LPAX-204-R-2000	15.0	47.7	37.1	0.5
LPAX-206-R-2000	24.9	46.3	26.1	2.8
LPAX-217-R-2000	6.5	53.0	40.3	0.5
LPAX-311-R-2000	28.0	38.5	33.2	1.0
LPAX-401-R-2000	18.5	39.0	40.8	2.3
LPAX-408-R-2000	18.1	41.6	38.9	2.0

Interpretation of Watershed Condition

- Widespread urban/suburban development
- Most sites have high concentrations of chloride, nitrogen, and phosphorous; many sites with silt/sand deposition and erosion problems
- Sites 113 and 118 are near parking lots, extensive impervious surface. Site 118 channelized, stream bottom partially covered with cement
- Low fish IBI at Site 109 due to small stream size; site is upstream of Howard County Landfill
- Landfills adjacent or upstream of Sites 115, 203, and 206
- Odors noted at Sites 217 (strange odor) and 408 (treated sewage)

- Sites 401 and 408 very large - benthic IBI may not accurately represent condition

Little Patuxent River

Water Chemistry Information

Site	Closed pH	Specific Cond.	ANC (ueq/L)	Cl (mg/L)	Nitrate-N (mg/L)	SO4 (mg/L)	P-P (mg/L)	TD-P (mg/L)	Ortho-P (mg/L)	Nitrite (mg/L)	Ammonia (mg/L)	TD-N (mg/L)	P-N (mg/L)	P-C (mg/L)	DOC (mg/L)	DO (mg/L)	Turbidity (NTUs)
LPAX-109-R-2000	7.04	239.6	338.2	46.499	4.581	1.735	0.001	0.005	0.003	0.008	0.016	5.026	0.040	0.222	0.938	9.1	3.9
LPAX-112-R-2000	7.67	160.0	540.4	21.639	2.466	5.108	0.006	0.016	0.006	0.000	0.000	2.554	0.070	0.479	1.692	8.3	20.8
LPAX-113-R-2000	8.70	317.2	540.4	43.162	2.717	17.040	0.091	0.591	0.578	0.083	0.047	3.334	0.077	0.555	2.387	9.6	4.7
LPAX-115-R-2000	7.37	231.7	907.3	32.781	2.154	6.891	0.003	0.007	0.003	0.013	0.034	2.357	0.056	0.416	1.770	7.4	10.5
LPAX-116-R-2000	7.77	468.8	1706.8	72.183	1.182	18.444	0.003	0.005	0.004	0.000	0.010	1.670	0.029	0.118	3.547	7.5	3.4
LPAX-118-R-2000	8.06	469.1	880.0	94.340	0.320	20.216	0.006	0.011	0.001	0.000	0.000	0.701	0.127	1.147	6.454	6.2	26.2
LPAX-203-R-2000	6.67	205.3	567.8	28.545	0.807	20.165	0.003	0.006	0.000	0.000	0.004	1.093	0.025	0.284	2.411	7.5	21.6
LPAX-204-R-2000	7.52	311.7	1359.4	42.052	2.394	12.567	0.006	0.011	0.004	0.000	0.012	2.420	0.104	0.270	1.455	7.7	4.7
LPAX-206-R-2000	6.82	219.2	610.5	31.184	0.863	20.094	0.004	0.007	0.000	0.000	0.012	0.997	0.037	0.387	2.294	6.8	6.2
LPAX-217-R-2000	7.44	310.7	1185.5	47.268	1.291	10.411	0.004	0.019	0.002	0.011	0.029	1.427	0.043	0.374	2.651	7.2	12
LPAX-311-R-2000	7.74	388.6	1412.3	59.302	1.352	13.666	0.007	0.010	0.000	0.000	0.004	1.906	0.042	0.341	2.006	6.5	4.1
LPAX-401-R-2000	7.69	375.1	1259.5	55.279	1.659	17.758	0.015	0.026	0.014	0.000	0.013	2.014	0.064	0.421	2.881	9.6	1.4
LPAX-408-R-2000	7.26	349.1	1354.0	48.928	1.742	19.020	0.012	0.103	0.097	0.002	0.029	2.029	0.053	0.492	2.742	7.6	2.5

Physical Habitat Condition

Site	Riparian Buffer Width Left	Riparian Buffer Width Right	Adjacent Cover Left	Adjacent Cover Right	Instream Habitat Structure	Epifaunal Substrate	Velocity/ Depth Diversity	Pool/Glide/ Eddy Quality	Extent of Pools (m)	Riffle Run Quality	Extent of Riffles (m)	Embedded-ness	Shading	Trash Rating	Maximum Depth (cm)
LPAX-109-R-2000	50	50	DU	LN	16	16	7	7	30	15	60	20	85	18	34
LPAX-112-R-2000	25	20	LN	LN	13	13	12	13	40	12	50	35	85	14	87
LPAX-113-R-2000	50	10	HO	PK	18	17	17	15	37	16	75	15	88	15	83
LPAX-115-R-2000	50	50	PV	FR	12	16	9	8	67	14	24	24	28	16	46
LPAX-116-R-2000	1	10	LN	LN	16	16	13	13	50	16	40	35	90	15	61
LPAX-118-R-2000	30	3	PK	PV	8	10	7	7	65	6	30	15	80	2	37
LPAX-203-R-2000	50	50	FR	TG	16	17	16	14	60	16	47	40	96	4	70
LPAX-204-R-2000	50	50	HO	HO	5	4	11	11	50	15	70	50	90	13	54
LPAX-206-R-2000	50	30	LF	LF	16	6	11	15	75	11	10	42	93	1	98
LPAX-217-R-2000	50	50	FR	FR	17	15	16	16	70	16	30	25	90	15	73
LPAX-311-R-2000	50	40	HO	PK	7	6	16	13	70	14	16	60	87	7	112
LPAX-401-R-2000	50	50	FR	FR	18	16	19	18	70	17	60	42	75	16	250
LPAX-408-R-2000	50	42	FR	GR	16	15	19	18	60	17	40	45	60	8	131

Physical Habitat Modifications

Site	Buffer Breaks?	Surface Mine?	Landfill?	Channelization?	Erosion Severity Left	Erosion Severity Right	Bar Formation
LPAX-109-R-2000	N	N	Y	N	Moderate	Mild	Minor
LPAX-112-R-2000	Y	N	N	N	Moderate	Moderate	Moderate
LPAX-113-R-2000	Y	N	N	N	Moderate	Moderate	Severe
LPAX-115-R-2000	N	N	Y	N	Mild	Mild	Minor
LPAX-116-R-2000	N	N	N	N	Severe	Moderate	Severe
LPAX-118-R-2000	Y	N	N	Y	Mild	Moderate	Severe
LPAX-203-R-2000	N	N	N	N	Moderate	Moderate	Severe
LPAX-204-R-2000	N	N	N	N	Moderate	Severe	Severe
LPAX-206-R-2000	Y	N	Y	N	Severe	Moderate	Severe
LPAX-217-R-2000	N	N	N	Y	Moderate	Moderate	Moderate

LPAX-311-R-2000	N	N	N	N	Severe	Severe	Severe
LPAX-401-R-2000	N	N	N	N	Moderate	Severe	Severe
LPAX-408-R-2000	Y	N	N	N	Mild	Severe	Severe

Little Patuxent River

Fish Species Present

AMERICAN BROOK LAMPREY
AMERICAN EEL
BLACKNOSE DACE
BLUEGILL
COMMON SHINER
CREEK CHUB
CUTLIPS MINNOW
EASTERN MUDMINNOW
FALLFISH
FATHEAD MINNOW
GLASSY DARTER
GOLDEN SHINER
GREEN SUNFISH
LARGEMOUTH BASS
LEAST BROOK LAMPREY
LEPOMIS HYBRID
LONGNOSE DACE
MARGINED MADTOM
MOSQUITOFISH
NORTHERN HOGSUCKER
PUMPKINSEED
REDBREAST SUNFISH
REDFIN PICKEREL
RIVER CHUB
ROSYFACE SHINER
ROSYSIDE DACE
SATINFIN SHINER
SEA LAMPREY
SHIELD DARTER
SMALLMOUTH BASS
SPOTTAIL SHINER
SWALLOWTAIL SHINER
TESSELLATED DARTER
WHITE SUCKER
YELLOW BULLHEAD

Exotic Plants Present

JAPANESE HONEYSUCKLE
MICROSTEGIUM
THISTLE

Benthic Taxa Present

ABLABESMYIA
AMPHINEMURA
ANCHYTARSUS
ANCYRONYX
ANTOCHA
BRILLIA
COLLEMBOLA
CAECIDOTEA
CENTROPTILUM
CHELIFERA
CHEUMATOPSYCHE
CHIMARRA
CHRYSOPS
CLINOCERA
CONCHAPELOPIA
CORBICULA
CORYNONEURA
CRANGONYX
CRICOTOPUS
CRICOTOPUS/ORTHOCLADIUS
DYTISCIDAE
DIAMESA
DICROTENDIPES
DIPLECTRONA
DIPLOCLADIUS
DUBIRAPHIA
DUGESIA
ENCHYTRAEIDAE
ECCOPTURA
ENDOCHIRONOMUS
EPHEMERELLA
EUKIEFFERIELLA
EURYLOPHELLA
GORDIIDAE
GLOSSOSOMA
HEPTAGENIIDAE
HELICHUS
HEMERODROMIA
HEXATOMA
HYDROBAENUS
HYDROPORUS
HYDROPSYCHE
ISONYCHIA
ISOTOMURUS
LUMBRICULIDAE
LARSIA
MACROMIA

MACRONYCHUS
MICROPSECTRA

MICROTENDIPES
NAIDIDAE
NANOCLADIUS
NEOPHYLAX
NIGRONIA
ORTHOCLADIINAE
OPTIOSERVUS
ORMOSIA
ORTHOCLADIINAE A
ORTHOCLADIUS
OULIMNIUS
PARACAPNIA
PARALEPTOPHLEBIA
PARAMETRIOCNEMUS
PARAPHAENOCLADIUS
PARATANYTARSUS
PARATENDIPES
PHYSELLA
PISIDIUM
POLYPEDILUM
POTTHASTIA
PROSIMILIUM
PROSTOIA
PSILOTRETA
RHEOCRICOTOPUS
RHEOTANYTARSUS
SIMULIIDAE
SPHAERIIDAE
SAETHERIA
SERRATELLA
SIMULIUM
STEGOPTERNA
STENACRON
STENELMIS
STENONEMA
STICTOCHIRONOMUS
STILOBEZZIA
STILOCLADIUS
SYMPOSIOLCLADIUS
SYMPOTTHASTIA
TIPULIDAE
TUBIFICIDAE
TAENIOPTERYX
TANYTARSUS
THIENEMANNIELLA
TIPULA
TRIBELOS
TRISSOPELOPIA

TVETENIA
ZAVRELIMYIA

Herpetofauna Present

AMERICAN TOAD
BULLFROG
COMMON SNAPPING TURTLE
EASTERN BOX TURTLE
FOWLER'S TOAD
GREEN FROG
NORTHERN CRICKET FROG
NORTHERN TWO-LINED SALAMANDER
NORTHERN WATER SNAKE
PICKEREL FROG
RED SALAMANDER
SOUTHERN LEOPARD FROG

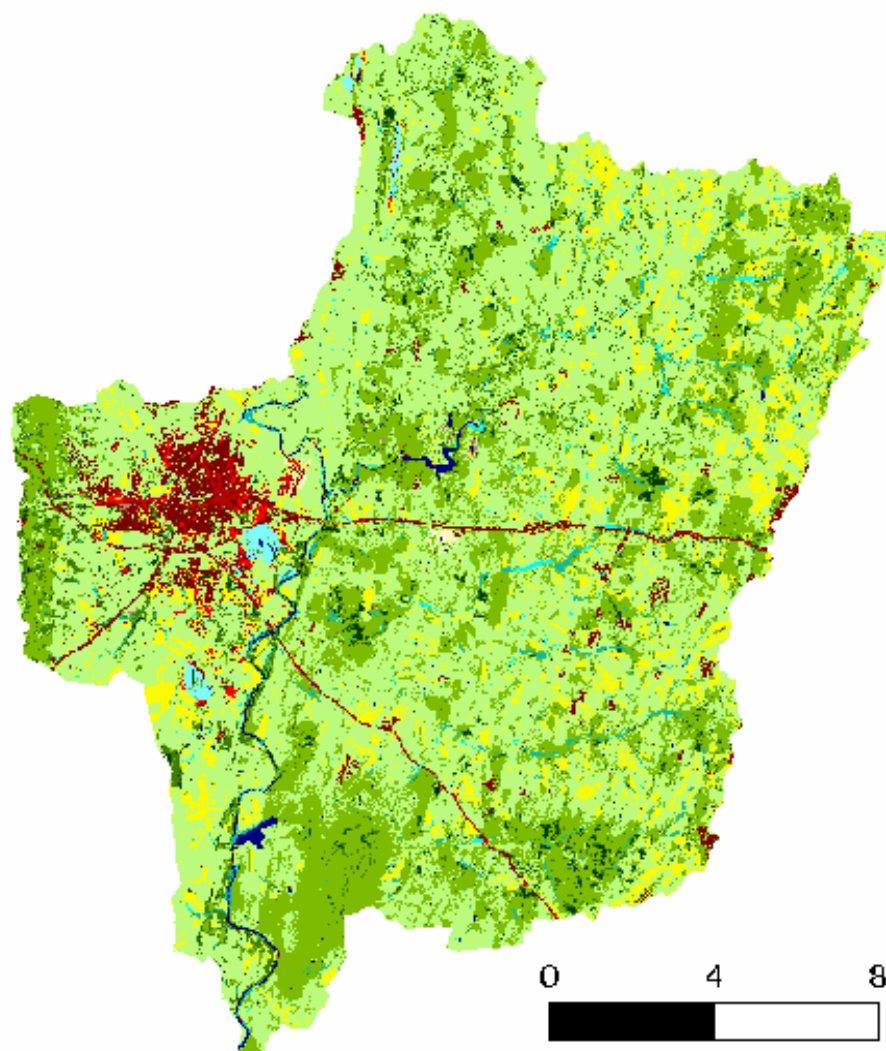


Lower Monocacy watershed MBSS 2000



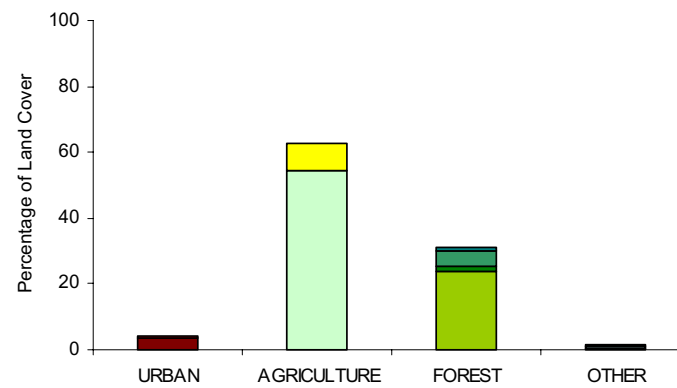
Watershed	Total Land Area (acres)	Total Stream Miles
Lower Monocacy River	194686	462

Lower Monocacy River



0 4 8
Miles

Lower Monocacy River



Lower Monocacy River

Site Information

Site	Stream Name	12-digit Subwatershed Code	8-digit Watershed	Basin	County	Date Sampled Spring	Date Sampled Summer	Order	Catchment Area (acres)
LMON-101-T-2000	LAUREL BR	021403020237	Lower Monocacy River	MIDDLE POTOMAC RIVER	Frederick	03/14/00	06/27/00	1	885
LMON-104-T-2000	WOODVILLE BR	021403020235	Lower Monocacy River	MIDDLE POTOMAC RIVER	Frederick	03/14/00	07/05/00	1	726
LMON-106-T-2000	LAUREL BR	021403020237	Lower Monocacy River	MIDDLE POTOMAC RIVER	Frederick	03/14/00	06/29/00	1	815
LMON-119-T-2000	TALBOT BR UT1	021403020238	Lower Monocacy River	MIDDLE POTOMAC RIVER	Frederick	03/27/00	06/22/00	1	223
LMON-122-T-2000	DORCUS BR	021403020239	Lower Monocacy River	MIDDLE POTOMAC RIVER	Frederick	03/27/00	06/27/00	1	897
LMON-130-T-2000	BEAR BR	021403020224	Lower Monocacy River	MIDDLE POTOMAC RIVER	Frederick	03/30/00	07/11/00	1	47
LMON-136-T-2000	LAUREL BR UT1	021403020237	Lower Monocacy River	MIDDLE POTOMAC RIVER	Frederick	03/27/00	06/27/00	1	225
LMON-147-T-2000	DOLLYHIDE CR UT1	021403020236	Lower Monocacy River	MIDDLE POTOMAC RIVER	Frederick	03/29/00	06/27/00	1	263
LMON-202-T-2000	HATCHERY RUN	021403020222	Lower Monocacy River	MIDDLE POTOMAC RIVER	Frederick	03/15/00	07/06/00	2	1525
LMON-203-T-2000	ISRAEL CR	021403020239	Lower Monocacy River	MIDDLE POTOMAC RIVER	Frederick	03/27/00	06/29/00	2	4532
LMON-209-T-2000	WELDON CR	021403020238	Lower Monocacy River	MIDDLE POTOMAC RIVER	Frederick	03/29/00	06/28/00	2	2548
LMON-210-T-2000	CABBAGE RUN	021403020237	Lower Monocacy River	MIDDLE POTOMAC RIVER	Frederick	03/14/00	06/28/00	2	2118
LMON-220-T-2000	ROCK CR	021403020233	Lower Monocacy River	MIDDLE POTOMAC RIVER	Frederick	03/15/00	07/13/00	2	2271
LMON-227-T-2000	BUSH CR	021403020228	Lower Monocacy River	MIDDLE POTOMAC RIVER	Frederick	03/27/00	07/05/00	2	3426
LMON-231-T-2000	BALLENGER CR UT1 UT1	021403020230	Lower Monocacy River	MIDDLE POTOMAC RIVER	Frederick	03/29/00	07/11/00	2	146
LMON-237-T-2000	CARROLL CR	021403020233	Lower Monocacy River	MIDDLE POTOMAC RIVER	Frederick	03/29/00	07/18/00	2	2871
LMON-239-T-2000	HORSEHEAD RUN	021403020227	Lower Monocacy River	MIDDLE POTOMAC RIVER	Frederick	03/29/00	09/28/00	2	1042
LMON-240-T-2000	LITTLE BENNETT CR	021403020223	Lower Monocacy River	MIDDLE POTOMAC RIVER	Montgomery	03/30/00	07/17/00	2	2116
LMON-252-T-2000	CHURCH BR	021403020228	Lower Monocacy River	MIDDLE POTOMAC RIVER	Frederick	03/30/00	07/06/00	2	2899
LMON-316-T-2000	BUSH CR	021403020229	Lower Monocacy River	MIDDLE POTOMAC RIVER	Frederick	03/15/00	09/25/00	3	20038
LMON-421-T-2000	BENNETT CR	021403020224	Lower Monocacy River	MIDDLE POTOMAC RIVER	Frederick	03/15/00	10/02/00	4	42176

Lower Monocacy Watershed

Indicator Information

Site	FIBI	BIBI	PHI	Brook Trout Present	Blackwater Stream
LMON-101-T-2000	1.57	2.78	48.82	0	0
LMON-104-T-2000	3.29	3.44	45.76	0	0
LMON-106-T-2000	1.57	1.67	29.18	0	0
LMON-119-T-2000	NR	4.56	80.95	0	0
LMON-122-T-2000	1.86	2.78	16.20	0	0
LMON-130-T-2000	NR	4.33	26.71	0	0
LMON-136-T-2000	NR	3.22	20.14	0	0
LMON-147-T-2000	NR	2.33	4.77	0	0
LMON-202-T-2000	3.57	3.67	30.91	0	0
LMON-203-T-2000	3.29	3.89	45.76	0	0
LMON-209-T-2000	3.57	4.56	97.22	0	0
LMON-210-T-2000	3.29	4.11	51.89	0	0
LMON-220-T-2000	3.00	1.67	50.87	0	0
LMON-227-T-2000	3.29	4.11	99.42	0	0
LMON-231-T-2000	NR	1.89	11.58	0	0
LMON-237-T-2000	2.43	2.56	63.80	0	0
LMON-239-T-2000	2.71	2.33	25.14	0	0
LMON-240-T-2000	3.29	4.56	74.23	0	0
LMON-252-T-2000	3.57	4.33	92.49	0	0
LMON-316-T-2000	4.71	3.44	86.49	0	0
LMON-421-T-2000	2.43	3.44	37.33	0	0

Catchment Land Use Information

Site	Percent Urban	Percent Agriculture	Percent Forest	Percent Other
LMON-101-T-2000	1.1	52.6	37.5	8.8
LMON-104-T-2000	14.7	67.1	18.2	0.1
LMON-106-T-2000	0.8	50.2	39.7	9.4
LMON-119-T-2000	0.7	80.4	18.9	0.0
LMON-122-T-2000	0.6	54.5	39.4	5.5
LMON-130-T-2000	0.0	0.0	100.0	0.0
LMON-136-T-2000	0.0	42.3	57.7	0.0
LMON-147-T-2000	0.0	96.5	3.4	0.1
LMON-202-T-2000	0.2	85.2	13.7	0.9
LMON-203-T-2000	0.1	70.7	28.9	0.2
LMON-209-T-2000	0.1	51.5	48.0	0.4
LMON-210-T-2000	0.3	56.7	42.7	0.3
LMON-220-T-2000	20.9	34.7	44.1	0.4
LMON-227-T-2000	6.9	50.5	42.6	0.0
LMON-231-T-2000	7.3	77.0	11.4	4.3
LMON-237-T-2000	4.7	69.1	26.3	0.0
LMON-239-T-2000	0.3	78.0	20.8	0.9
LMON-240-T-2000	4.7	60.4	34.8	0.1
LMON-252-T-2000	4.8	63.8	31.0	0.4
LMON-316-T-2000	3.3	61.7	34.2	0.8
LMON-421-T-2000	1.8	58.9	39.0	0.4

Interpretation of Watershed Condition

- Much of watershed is agricultural, but also includes City of Frederick and rapidly growing suburban areas
- Nitrogen concentrations high at most sites; phosphorous high at some sites
- Poor riparian buffer at many sites
- A few low PHI scores are because of small stream size
- Site 136 probably dry in late summer
- Agricultural impacts noted at several sites, including some where cows have access to stream
- Urban impacts (culvert, trash) noted at a few sites
- Some sites appear to receive fine materials from nearby cement plant

Lower Monocacy Watershed

Water Chemistry Information

Site	Closed pH	Specific Cond.	ANC (ueq/L)	Cl (mg/L)	Nitrate-N (mg/L)	SO4 (mg/L)	P-P (mg/L)	TD-P (mg/L)	Ortho-P (mg/L)	Nitrite (mg/L)	Ammonia (mg/L)	TD-N (mg/L)	P-N (mg/L)	P-C (mg/L)	DOC (mg/L)	DO (mg/L)	Turbidity (NTUs)
LMON-101-T-2000	7.72	549.6	1483.4	12.203	0.363	173.957	0.001	0.007	0.002	0.007	0.009	0.461	0.012	0.331	1.616	6.3	8.5
LMON-104-T-2000	7.48	237.4	960.3	27.049	3.483	9.800	0.001	0.006	0.005	0.008	0.009	3.665	0.028	0.205	1.009	8.3	4.2
LMON-106-T-2000	7.68	604.2	1614.8	34.338	0.366	566.027	0.002	0.005	0.003	0.007	0.011	0.525	0.024	0.207	1.650	5.6	9.8
LMON-119-T-2000	6.87	113.7	186.5	17.525	3.049	3.442	0.001	0.007	0.002	0.000	0.017	3.293	0.024	0.227	0.946	7.9	4
LMON-122-T-2000	7.94	191.3	602.8	12.455	1.192	34.642	0.003	0.006	0.003	0.003	0.029	1.264	0.024	0.199	1.593	7.2	6.5
LMON-130-T-2000	5.87	222.6	43.9	1.617	0.000	3.027	0.000	0.004	0.000	0.000	0.000	0.075	0.011	0.083	2.097	5.1	3.5
LMON-136-T-2000	6.93	118.9	378.7	15.712	0.445	10.025	0.001	0.005	0.000	0.000	0.014	0.588	0.046	0.400	1.478	5.6	3.2
LMON-147-T-2000	7.86	302.0	2335.8	18.387	3.636	14.587	0.014	0.042	0.028	0.000	0.020	3.930	0.091	0.345	2.567	6.8	40
LMON-202-T-2000	8.08	499.1	3613.5	30.010	6.455	25.866	0.003	0.010	0.003	0.000	0.016	6.621	0.068	0.632	1.141	7.3	8.5
LMON-203-T-2000	7.56	159.2	776.7	12.061	2.256	10.646	0.005	0.033	0.027	0.004	0.020	2.572	0.031	0.238	1.427	8	13.4
LMON-209-T-2000	7.47	120.8	506.6	10.047	1.962	6.365	0.002	0.012	0.008	0.000	0.000	2.121	0.008	0.098	1.133	8.3	5.6
LMON-210-T-2000	7.62	146.2	456.0	18.825	1.912	9.256	0.002	0.012	0.003	0.008	0.010	2.221	0.040	0.369	1.165	8.5	4.3
LMON-220-T-2000	8.44	573.5	2362.1	75.897	1.750	18.893	0.001	0.007	0.001	0.000	0.001	1.850	0.041	0.370	1.410	8.4	2.5
LMON-227-T-2000	7.37	271.5	661.6	49.152	2.694	9.244	0.003	0.014	0.012	0.007	0.030	2.858	0.049	0.393	1.892	9.4	3.6
LMON-231-T-2000	6.95	348.0	817.6	50.489	3.101	29.399	0.019	0.037	0.019	0.021	0.098	3.495	0.068	0.604	5.261	3.1	6.5
LMON-237-T-2000	7.66	412.3	2844.2	26.710	3.064	12.110	0.004	0.024	0.013	0.000	0.012	3.282	0.032	0.363	1.291	8.1	5.8
LMON-239-T-2000	7.81	583.4	1668.3	20.695	10.567	24.568	0.006	0.010	0.000	0.000	0.013	10.684	0.033	0.306	1.121	10.1	17.3
LMON-240-T-2000	7.53	180.3	486.4	25.589	3.207	7.083	0.001	0.008	0.003	0.000	0.000	3.444	0.020	0.159	1.739	8.6	5.5
LMON-252-T-2000	7.21	134.4	376.8	17.041	2.459	5.660	0.004	0.008	0.002	0.000	0.000	2.714	0.025	0.183	1.296	8.3	4.9
LMON-316-T-2000	8.80	238.9	974.4	33.859	1.824	12.368	0.003	0.015	0.005	0.000	0.007	1.943	0.097	0.636	1.572	9.3	3.4
LMON-421-T-2000	8.12	170.7	705.3	21.036	1.815	8.661	0.002	0.008	0.001	0.000	0.000	2.112	0.037	0.301	1.265	9.5	4.7

Physical Habitat Condition

Site	Riparian Buffer Width Left	Riparian Buffer Width Right	Adjacent Cover Left	Adjacent Cover Right	Instream Habitat Structure	Epifaunal Substrate	Velocity/ Depth Diversity	Pool/Glide/ Eddy Quality	Extent of Pools (m)	Riffle/Run Quality	Extent of Riffles (m)	Embedded- ness	Shading	Trash Rating	Maximum Depth (cm)
LMON-101-T-2000	50	50	SL	CP	14	13	10	13	42	14	33	35	60	18	47
LMON-104-T-2000	50	50	OF	TG	12	13	7	10	37	15	38	35	65	18	48
LMON-106-T-2000	50	14	TG	CP	12	11	9	11	51	12	24	50	65	17	45
LMON-119-T-2000	50	50	FR	FR	16	15	11	12	36	13	39	30	90	20	52
LMON-122-T-2000	0	0	DI	DI	7	5	8	8	31	11	44	25	55	12	42
LMON-130-T-2000	50	50	FR	FR	8	13	7	3	29	6	41	40	95	20	11
LMON-136-T-2000	50	50	FR	FR	11	13	6	6	39	7	36	30	90	17	28
LMON-147-T-2000	0	0	PA	PA	5	4	6	7	37	7	38	75	10	18	21
LMON-202-T-2000	20	2	PV	CP	8	7	14	13	36	12	42	50	90	16	93
LMON-203-T-2000	0	0	PA	PA	7	6	14	15	70	13	5	35	35	18	62
LMON-209-T-2000	50	50	FR	FR	15	14	15	16	39	15	40	25	70	19	78
LMON-210-T-2000	0	0	PA	PA	11	13	8	9	43	16	32	25	10	18	39
LMON-220-T-2000	50	50	HO	HO	14	13	14	14	40	13	35	25	70	8	96
LMON-227-T-2000	50	40	TG	PV	16	17	15	15	24	16	51	35	70	10	64
LMON-231-T-2000	0	0	PA	PA	7	10	5	6	51	6	24	40	75	13	27
LMON-237-T-2000	0	0	PA	PA	12	9	14	15	53	14	30	35	15	18	53
LMON-239-T-2000	8	30	CP	PA	6	4	11	12	75	11	5	100	25	15	78
LMON-240-T-2000	50	50	FR	FR	9	8	11	12	57	12	30	25	45	15	52
LMON-252-T-2000	0	0	PA	PA	17	18	15	13	8	17	67	20	90	16	61
LMON-316-T-2000	5	2	RR	SL	16	16	15	12	17	18	75	20	45	18	54
LMON-421-T-2000	13	50	CP	FR	13	11	10	20	75	0	0	30	65	14	121

Physical Habitat Modifications

Site	Buffer Breaks?	Surface Mine?	Landfill?	Channelization?	Erosion Severity Left	Erosion Severity Right	Bar Formation
LMON-101-T-2000	N	Y	N	N	Moderate	Moderate	Minor
LMON-104-T-2000	N	N	N	N	Severe	Moderate	Minor
LMON-106-T-2000	N	Y	N	N	Moderate	Mild	Minor
LMON-119-T-2000	N	N	N	N	Moderate	Moderate	Moderate
LMON-122-T-2000	Y	Y	N	Y	Moderate	Moderate	Moderate
LMON-130-T-2000	N	N	N	N	None	None	Minor
LMON-136-T-2000	N	N	N	N	Moderate	Moderate	Severe
LMON-147-T-2000	Y	N	N	N	Moderate	Moderate	Minor
LMON-202-T-2000	Y	N	N	N	Moderate	Moderate	Severe
LMON-203-T-2000	Y	N	N	N	Mild	Severe	Minor
LMON-209-T-2000	N	N	N	N	Moderate	Severe	Moderate
LMON-210-T-2000	Y	N	N	N	Moderate	Moderate	Minor
LMON-220-T-2000	N	N	N	Y	Severe	Moderate	Moderate
LMON-227-T-2000	N	N	N	N	Mild	Mild	Moderate
LMON-231-T-2000	Y	N	N	N	Mild	Mild	Minor
LMON-237-T-2000	Y	N	N	N	Moderate	Moderate	None
LMON-239-T-2000	N	N	N	Y	Mild	None	None
LMON-240-T-2000	N	N	N	N	Moderate	Mild	Severe
LMON-252-T-2000	Y	N	N	N	Moderate	Moderate	Minor

LMON-316-T-2000	Y	N	N	N	Mild	Moderate	Minor
LMON-421-T-2000	N	N	N	Y	Moderate	Moderate	None

Lower Monocacy River

Fish Species Present

BANDED KILLIFISH
 BLACKNOSE DACE
 BLUEGILL
 BLUNTNOST MINNOW
 CENTRAL STONEROLLER
 CHECKERED SCULPIN
 COMMON SHINER
 CREEK CHUB
 CREEK CHUBSUCKER
 CUTLIPS MINNOW
 EASTERN SILVERY MINNOW
 FANTAIL DARTER
 FATHEAD MINNOW
 GOLDEN REDHORSE
 GOLDEN SHINER
 GREEN SUNFISH
 GREENSIDE DARTER
 LARGEMOUTH BASS
 LEPOMIS HYBRID
 LONGEAR SUNFISH
 LONGNOSE DACE
 MOSQUITOFISH
 MOTTLED SCULPIN
 NORTHERN HOGSUCKER
 PEARL DACE
 POTOMAC SCULPIN
 PUMPKINSEED
 RAINBOW DARTER
 REDBREAST SUNFISH
 ROCK BASS
 ROSYFACE SHINER
 ROSYSIDE DACE
 SILVERJAW MINNOW
 SMALLMOUTH BASS
 SPOTFIN SHINER
 SPOTTAIL SHINER
 TESSELLATED DARTER
 WHITE SUCKER
 YELLOW BULLHEAD

Exotic Plants Present

JAPANESE HONEYSUCKLE
 MILE-A-MINUTE
 MULTIFLORA ROSE
 THISTLE

Benthic Taxa Present

ACERPENNA
 AGABUS
 AMELETUS
 AMPHINEMURA
 ANCYRONYX
 ANTOCHA
 APSECTROTANYPUS
 ARGIA
 BAETIDAE
 BAETISCA
 BRILLIA
 CAPNIIDAE
 CERATOPOGONIDAE
 COENAGRIONIDAE
 COLLEMBOLA
 CORIXIDAE
 CAECIDOTEA
 CAENIS
 CENTROPTILUM
 CHELIFERA
 CHEUMATOPSYCHE
 CHIMARRA
 CHIRONOMUS
 CLADOTANYTARSUS
 CLINOCERA
 CLINOTANYPUS
 CLIOPERLA
 CONCHAPELOPIA
 CONSTEMPELLINA
 CORDULEGASTER
 CORYNONEURA
 CRANGONYX
 CRICOTOPUS
 CRICOTOPUS/ORTHOCLADIUS
 CRYPTOCHIRONOMUS
 CULICOIDES
 DIAMESA
 DICRANOTA
 DICROTENDIPES
 DIPHETOR
 DIPLOCLADIUS
 DIXA
 DUBIRAPHIA

DUGESIA
 ENCHYTRAEIDAE
 ENALLAGMA
 ENDOCHIRONOMUS
 EPEORUS
 EPHEMERA
 EPHEMERELLA
 EUKIEFFERIELLA
 EURYLOPHELLA
 FERRISSIA
 GOMPHIDAE
 GORDIIDAE
 GAMMARUS
 HABROPHLEBIA
 HELENIELLA
 HEMERODROMIA
 HETEROTRISOCLADIUS
 HEXATOMA
 HYALELLA
 HYDROBAENUS
 HYDROPORUS
 HYDROPSYCHE
 IRONOQUIA
 ISCHNURA
 ISONYCHIA
 ISOPERLA
 KRENOPELOPIA
 LUMBRICULIDAE
 LARSIA
 LEPIDOSTOMA
 LEUCTRA
 LIMNOPHYES
 LIMONIA
 LIRCEUS
 LYPE
 MACROMIA
 MACRONYCHUS
 MACROPELOPIA
 MEROPELOPIA
 MICROPSPECTRA
 MICROTENDIPES
 MOLANNA
 NAIDIDAE
 NEMOURIDAE
 NANOCLADIUS
 NEOPHYLAX

NYCTIOPHYLAX
 ORTHOCLADIINAE
 OPTIOSERVUS
 ORTHOCLADIINAE A
 ORTHOCLADIUS
 OULIMNIUS
 PERLIDAE
 PERLODIDAE
 PHILOPOTAMIDAE
 PARAKIEFFERIELLA
 PARALEPTOPHLEBIA
 PARAMERINA
 PARAMETRIOCNEMUS
 PARAPHAENOCLADIUS
 PARATANYTARSUS
 PELTODYTES
 PHYSELLA
 PISIDIUM
 POLYCENTROPUS
 POLYPEDILUM
 POTTHASTIA
 PROBEZZIA
 PROCLADIUS
 PROSIMULIUM
 PROSTOIA
 PROSTOMA
 PSEPHENUS
 PSEUDOLIMNOPHILA
 PSILOMETRIOCNEMUS
 PSILOTRETA
 PTYCHOPTERA
 PYCNOPSYCHE
 RHEOCRICOTOPUS
 RHEOTANYTARSUS
 RHYACOPHILA
 SIMULIIDAE
 SPHAERIIDAE
 SERRATELLA
 SIMULIUM
 SIPHLONURUS
 STAGNICOLA
 STEGOPTERNA
 STEMPPELLINELLA
 STENACRON
 STENELMIS
 STENONEMA

STICTOCHIRONOMUS
STILOCLADIUS
STROPHOPTERYX
SWELTS
SYMPOSIOCLADIUS
SYMPOTTHASTIA
TABANIDAE
TANYPODINAE
TANYTARSINI
TIPULIDAE
TUBIFICIDAE
TURBELLARIA
TANYTARSUS
THIENEMANNIELLA
TIPULA
TRISSOPELOPIA
TVETENIA
ZAVRELIMYIA

Herpetofauna Present

AMERICAN TOAD
BLACK RAT SNAKE
BULLFROG
COMMON SNAPPING TURTLE
EASTERN BOX TURTLE
EASTERN GARTER SNAKE
EASTERN RIBBON SNAKE
FOWLER'S TOAD
GREEN FROG
NONE
NORTHERN DUSKY SALAMANDER
NORTHERN TWO-LINED SALAMANDER
NORTHERN WATER SNAKE
PICKEREL FROG
RED SALAMANDER
WOOD FROG

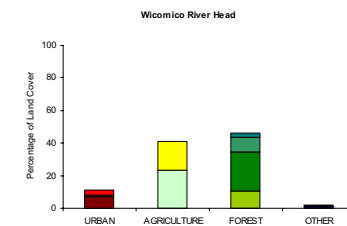
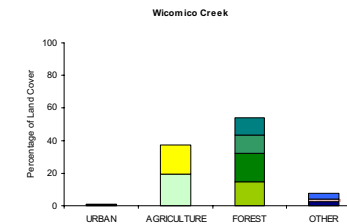
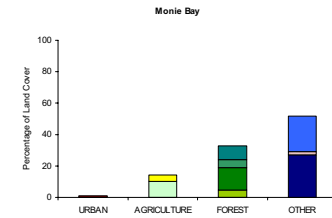
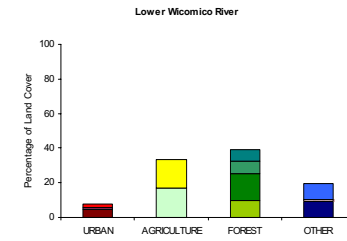
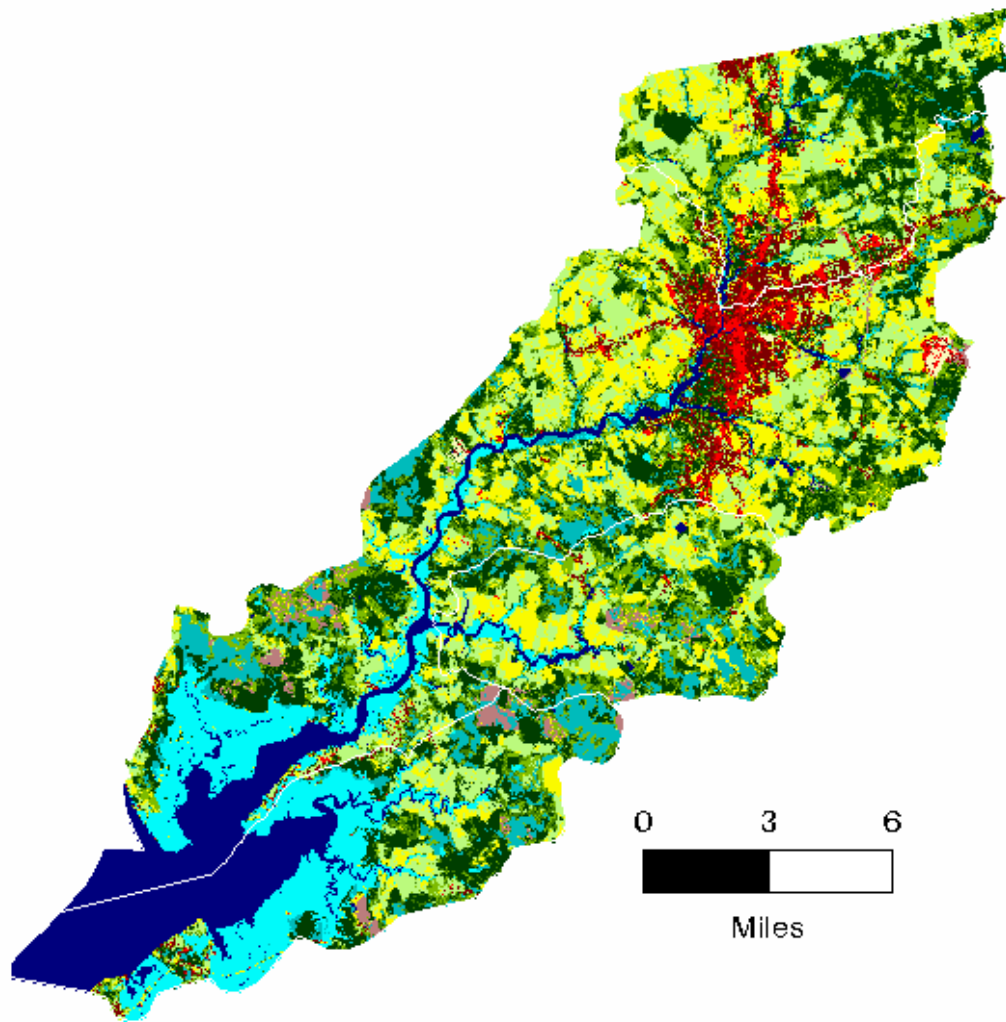


**Lower Wicomico River/Monie
Bay/Wicomico Creek/Wicomico
River Head watersheds
MBSS 2000**



Watershed	Total Land Area (acres)	Total Stream Miles
Lower Wicomico River	79771	33.1
Monie Bay	29580	4.4
Wicomico Creek	19962	14.3
Wicomico River Head	163699	39.6

Lower Wicomico River/Monie Bay/Wicomico Creek/Wicomico River Head



Lower Wicomico River/Monie Bay/Wicomico Creek/Wicomico River Head

Site Information

Site	Stream Name	12-digit Subwatershed Code	8-digit Watershed	Basin	County	Date Sampled Spring	Date Sampled Summer	Order	Catchment Area (acres)
LOWI-102-R-2000	WHITE MARSH CR	021303010558	Lower Wicomico River	NANTICOKE RIVER	Wicomico	03/28/00	08/02/00	1	770
LOWI-103-R-2000	ROCKAWALKIN CR	021303010559	Lower Wicomico River	NANTICOKE RIVER	Wicomico	03/27/00	07/31/00	1	377
LOWI-104-R-2000	MORRIS POND	021303010558	Lower Wicomico River	NANTICOKE RIVER	Wicomico	03/28/00	09/11/00	1	3298
LOWI-113-R-2000	BEAVERDAM CR	021303010562	Lower Wicomico River	NANTICOKE RIVER	Wicomico	03/28/00	10/03/00	1	1246
MONI-126-R-2000	MONIE CR	021303020544	Monie Bay	NANTICOKE RIVER	Somerset	03/27/00	07/31/00	1	1568
WIRH-108-R-2000	LITTLE BURNT BR	021303040567	Wicomico River Head	NANTICOKE RIVER	Wicomico	03/27/00	09/12/00	1	1752
WIRH-109-R-2000	LEONARD POND RUN	021303040568	Wicomico River Head	NANTICOKE RIVER	Wicomico	03/29/00	08/01/00	1	649
WIRH-111-R-2000	LEONARD POND RUN	021303040568	Wicomico River Head	NANTICOKE RIVER	Wicomico	03/29/00	08/01/00	1	1498
WIRH-114-R-2000	MORRIS BR	021303040569	Wicomico River Head	NANTICOKE RIVER	Wicomico	03/29/00	08/01/00	1	281
WIRH-215-R-2000	MIDDLE NECK BR	021303040566	Wicomico River Head	NANTICOKE RIVER	Wicomico	03/29/00	08/02/00	2	4168

Indicator Information

Site	FIBI	BIBI	PHI	Brook Trout Present	Black Water Stream
LOWI-102-R-2000	2.00	1.57	12.31	0	0
LOWI-103-R-2000	2.50	1.29	33.73	0	0
LOWI-104-R-2000	4.25	3.00	63.35	0	0
LOWI-113-R-2000	NR	1.00	20.64	0	1
MONI-126-R-2000	NR	1.00	79.43	0	1
WIRH-108-R-2000	NR	1.86	27.88	0	1
WIRH-109-R-2000	NR	1.00	14.75	0	1
WIRH-111-R-2000	NR	1.29	42.54	0	1
WIRH-114-R-2000	NR	1.86	12.43	0	1
WIRH-215-R-2000	3.00	2.14	79.79	0	0

Catchment Land Use Information

Site	Percent Urban	Percent Agriculture	Percent Forest	Percent Other
LOWI-102-R-2000	1.4	46.8	51.6	0.2
LOWI-103-R-2000	0.0	66.7	33.3	0.3
LOWI-104-R-2000	3.5	49.2	46.8	3.2
LOWI-113-R-2000	0.1	42.1	57.3	4.5
MONI-126-R-2000	0.0	2.0	92.6	5.8
WIRH-108-R-2000	0.1	66.4	33.3	0.6
WIRH-109-R-2000	0.1	6.1	93.8	0.1
WIRH-111-R-2000	0.0	13.2	86.7	0.1
WIRH-114-R-2000	0.0	36.9	59.2	3.8
WIRH-215-R-2000	21.5	36.6	40.7	1.3

Interpretation of Watershed Condition

- Some sites sampled were channelized ditches
- Others were within swamps, relatively good condition, few impacts noted. IBIs and physical habitat metrics likely to be low because of natural conditions (slow -moving water and muddy bottoms). Many blackwater streams.
- High concentrations of nitrogen and phosphorous
- Sites 103 and 113 downstream from chicken farms
- Site 215 is adjacent to railroad tracks

Lower Wicomico River/Monie Bay/Wicomico CR/Wicomico River Head

Water Chemistry Information

Site	Closed pH	Specific Cond.	ANC (ueq/L)	Cl (mg/L)	Nitrate-N (mg/L)	SO4 (mg/L)	P-P (mg/L)	TD-P (mg/L)	Ortho-P (mg/L)	Nitrite (mg/L)	Ammonia (mg/L)	TD-N (mg/L)	P-N (mg/L)	P-C (mg/L)	DOC (mg/L)	DO (mg/L)	Turbidity (NTUs)
LOWI-102-R-2000	6.30	75.8	232.5	8.695	0.626	3.396	0.002	0.033	0.020	0.010	0.042	1.291	0.056	0.598	17.746	5.1	2.8
LOWI-103-R-2000	6.60	144.0	347.7	13.896	3.848	10.134	0.002	0.016	0.008	0.000	0.017	4.153	0.051	0.524	6.924	4.9	2.1
LOWI-104-R-2000	6.56	95.5	288.3	10.422	1.203	6.247	0.017	0.041	0.019	0.008	0.061	1.646	0.130	1.275	12.618	6.8	2.2
LOWI-113-R-2000	5.63	87.4	57.3	10.614	0.919	9.971	0.010	0.090	0.070	0.003	0.099	1.914	0.253	1.064	16.018	5.4	5.1
MONI-126-R-2000	4.42	42.0	-47.5	3.339	0.000	1.594	0.002	0.018	0.003	0.000	0.035	0.997	0.112	1.277	41.757	3.3	4.4
WIRH-108-R-2000	6.48	60.3	180.1	4.371	1.105	5.047	0.018	0.093	0.071	0.012	0.070	1.610	0.252	1.271	9.380	6.2	2.2
WIRH-109-R-2000	4.31	55.9	-61.8	4.150	0.263	5.568	0.000	0.010	0.001	0.000	0.206	1.102	0.060	1.065	28.823	0.3	5
WIRH-111-R-2000	5.29	59.3	41.5	5.199	0.931	6.277	0.001	0.053	0.032	0.000	0.021	1.495	0.046	0.467	18.544	1.9	3
WIRH-114-R-2000	4.42	98.4	-38.2	10.040	0.993	14.345	0.002	0.016	0.003	0.000	0.028	1.640	0.065	0.749	18.600	4.1	5.9
WIRH-215-R-2000	6.57	145.0	350.9	17.649	2.724	8.699	0.011	0.387	0.350	0.000	0.070	3.585	0.104	1.156	12.839	5.1	2.1

Physical Habitat Condition

Site	Riparian Buffer Width Left	Riparian Buffer Width Right	Adjacent Cover Left	Adjacent Cover Right	Instream Habitat Structure	Epifaunal Substrate	Velocity/Depth Diversity	Pool/Glide/Eddy Quality	Extent of Pools (m)	Riffle Run Quality	Extent of Riffles (m)	Embedded-ness	Shading	Trash Rating	Maximum Depth (cm)
LOWI-102-R-2000	1	50	LN	FR	6	5	3	7	75	0	0	100	95	17	37
LOWI-103-R-2000	10	50	PV	CP	16	11	6	10	75	0	0	100	98	10	29
LOWI-104-R-2000	39	46	HO	HO	16	13	9	8	70	14	25	100	95	12	120
LOWI-113-R-2000	30	40	PA	CP	6	9	6	9	75	0	0	100	60	15	53
MONI-126-R-2000	40	12	CP	PV	16	12	14	15	75	0	0	100	96	15	58
WIRH-108-R-2000	20	30	CP	CP	17	17	5	6	50	10	35	100	95	13	29
WIRH-109-R-2000	40	30	LO	LO	7	5	4	7	75	0	0	100	97	18	31
WIRH-111-R-2000	50	50	HO	FR	18	12	5	10	75	0	0	100	85	13	38
WIRH-114-R-2000	0	0	CP	CP	5	5	4	8	75	0	0	100	60	15	38
WIRH-215-R-2000	40	5	HO	PK	19	16	17	14	75	0	0	100	80	1	80

Physical Habitat Modifications

Site	Buffer Breaks?	Surface Mine?	Landfill?	Channelization?	Erosion Severity Left	Erosion Severity Right	Bar Formation
LOWI-102-R-2000	Y	N	N	Y	Moderate	Moderate	None
LOWI-103-R-2000	N	N	N	N	None	None	None
LOWI-104-R-2000	N	N	N	N	None	None	None
LOWI-113-R-2000	N	N	N	Y	Mild	Mild	None
MONI-126-R-2000	N	N	N	Y	Mild	None	None
WIRH-108-R-2000	N	N	N	N	None	None	None
WIRH-109-R-2000	N	N	N	Y	None	None	None
WIRH-111-R-2000	N	N	N	N	None	None	None
WIRH-114-R-2000	N	N	N	Y	None	None	None

WIRH-215-R-2000	Y	N	N	N	None	None	None
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Lower Wicomico River/ Monie Bay/ Wicomico Creek/ Wicomico River Head

Fish Species Present

AMERICAN EEL
BANDED SUNFISH
BLUEGILL
BLUESPOTTED SUNFISH
BROWN BULLHEAD
CHAIN PICKEREL
CREEK CHUBSUCKER
EASTERN MUDMINNOW
GOLDEN SHINER
LARGEMOUTH BASS
LEAST BROOK LAMPREY
MOSQUITOFISH
PIRATE PERCH
PUMPKINSEED
REDFIN PICKEREL
SWAMP DARTER
TADPOLE MADTOM
TESSELLATED DARTER
YELLOW BULLHEAD

Exotic Plants Present

JAPANESE HONEYSUCKLE
MICROSTEGIUM
MILE-A-MINUTE
THISTLE

Benthic Taxa Present

AMPHIPODA
ABLABESMYIA
AGABUS
ARGIA
CERATOPOGONIDAE
CHIRONOMINAE
CHIRONOMINI
COENAGRIONIDAE
COLLEMBOLA
CRANGONYCTIDAE
CULICIDAE
CAECIDOTEA
CAENIS
CHEUMATOPSYCHE
CHIRONOMUS
CORYNONEURA
CRANGONYX
CRICOTOPUS
CRICOTOPUS/ORTHOCLADIUS
DOLICHOPODIDAE
DYTISCIDAE
ENCHYTRAETIDAE
ENALLAGMA
ENOCHRUS
EURYLOPHELLA
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GAMMARUS
HYALELLA
HYDROBAENUS
HYDROBIUS
HYDROPORUS
IRONOQUIA

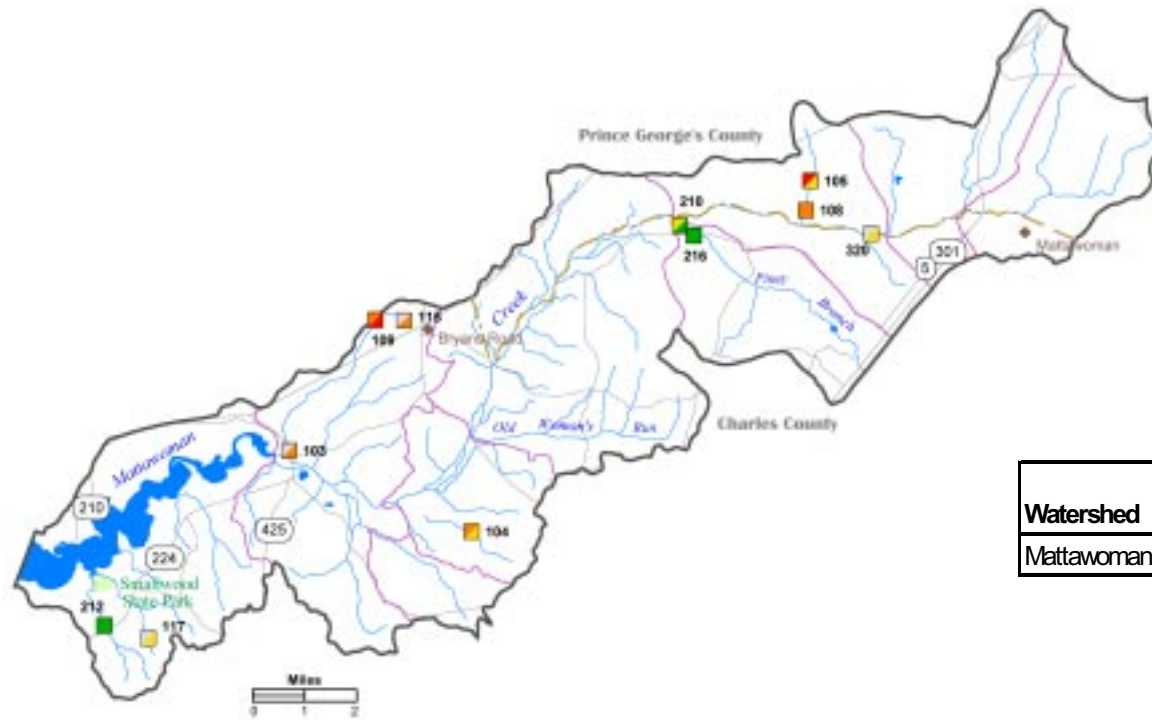
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MALLOCHOHELEA
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NAIDIDAE
NEMOURIDAE
NANOCLADIUS
ORTHOCLADIINAE
PARACHIRONOMUS
PELTODYTES
PHYSELLA
POLYPEDILUM
POTTHASTIA
PROSTOMA
RHEOCRICOTOPUS
SPHAERIIDAE
SIMULIUM
SMITTIA
SPHAERIUM
STAGNICOLA
STEGOPTERNA
STENONEMA
SYNURELLA
TANYTARSINI
TUBIFICIDAE
TANYTARSUS
THIENEMANNIELLA
TRIBELOS
TROPISTERNUS

Herpetofauna Present

BULLFROG
COMMON MUSK TURTLE
COMMON SNAPPING TURTLE
EASTERN PAINTED TURTLE
FOWLER'S TOAD
GREEN FROG
NORTHERN SPRING PEEPER
NORTHERN WATER SNAKE
PICKEREL FROG
SOUTHERN LEOPARD FROG

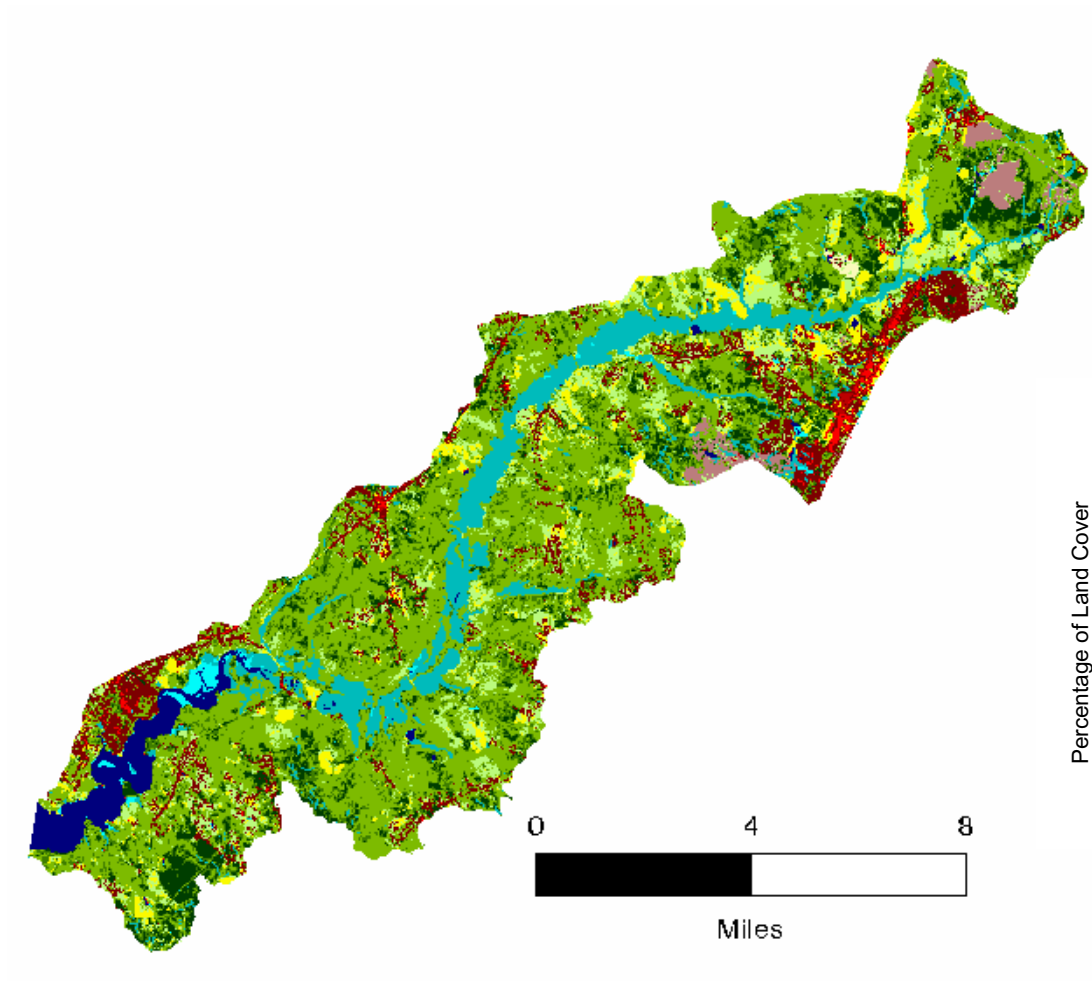


**Mattawoman Creek watershed
MBSS 2000**

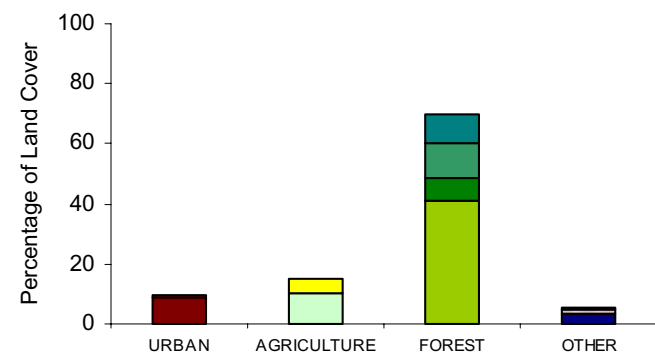


Watershed	Total Land Area (acres)	Total Stream Miles
Mattawoman Creek	62192	121.7

Mattawoman Creek



Mattawoman Creek



Mattawoman Creek

Site Information

Site	Stream Name	12-digit Subwatershed Code	8 - d i g i t Watershed	Basin	County	Date Sampled Spring	Date Sampled Summer	Order	Catchment Area (acres)
MATT-103-R-2000	MATTAWOMAN CR UT2	021401110781	Mattawoman CR	LOWER POTOMAC RIVER	Charles	03/07/00	NS	1	1640
MATT-104-R-2000	MATTAWOMAN CR UT3	021401110783	Mattawoman CR	LOWER POTOMAC RIVER	Charles	03/07/00	06/19/00	1	805
MATT-105-R-2000	MATTAWOMAN CR UT1	021401110786	Mattawoman CR	LOWER POTOMAC RIVER	Prince Georges	03/09/00	06/19/00	1	885
MATT-108-R-2000	MATTAWOMAN CR UT1	021401110786	Mattawoman CR	LOWER POTOMAC RIVER	Prince Georges	03/09/00	06/19/00	1	1192
MATT-109-R-2000	MATTAWOMAN CR UT2	021401110781	Mattawoman CR	LOWER POTOMAC RIVER	Charles	03/07/00	06/19/00	1	403
MATT-115-R-2000	MATTAWOMAN CR UT2	021401110781	Mattawoman CR	LOWER POTOMAC RIVER	Charles	03/07/00	06/21/00	1	211
MATT-117-R-2000	MATTAWOMAN CR UT4	021401110780	Mattawoman CR	LOWER POTOMAC RIVER	Charles	03/09/00	06/21/00	1	101
MATT-210-R-2000	PINEY BR	021401110785	Mattawoman CR	LOWER POTOMAC RIVER	Charles	03/07/00	08/23/00	2	5258
MATT-212-R-2000	MATTAWOMAN CR UT3	021401110780	Mattawoman CR	LOWER POTOMAC RIVER	Charles	03/08/00	06/21/00	2	886
MATT-216-R-2000	PINEY BR	021401110785	Mattawoman CR	LOWER POTOMAC RIVER	Charles	03/07/00	08/23/00	2	4859
MATT-320-R-2000	MATTAWOMAN CR	021401110786	Mattawoman CR	LOWER POTOMAC RIVER	Charles, Prince Georges	05/01/00	08/24/00	3	10955

Indicator Information

Site	FIBI	BIBI	PHI	Brook Trout Present	Black Water Stream
MATT-103-R-2000	NS	2.43	NS	NS	NS
MATT-104-R-2000	2.00	3.57	33.98	0	0
MATT-105-R-2000	1.75	3.00	97.07	0	0
MATT-108-R-2000	2.00	2.71	96.87	0	0
MATT-109-R-2000	2.75	1.86	79.61	0	0
MATT-115-R-2000	NR	2.14	89.72	0	0
MATT-117-R-2000	NR	3.29	26.57	0	0
MATT-210-R-2000	3.50	4.14	94.47	0	0
MATT-212-R-2000	4.25	4.71	87.74	0	0
MATT-216-R-2000	4.25	4.43	96.05	0	0
MATT-320-R-2000	3.00	3.57	89.82	0	1

Catchment Land Use

Site	Percent Urban	Percent Agriculture	Percent Forest	Percent Other
MATT-103-R-2000	16.7	7.6	75.2	0.6
MATT-104-R-2000	6.3	17.7	75.9	0.2
MATT-105-R-2000	0.6	13.9	85.5	0.0
MATT-108-R-2000	0.5	21.5	78.0	0.1
MATT-109-R-2000	38.4	5.9	55.7	0.0
MATT-115-R-2000	45.1	9.0	45.9	0.0
MATT-117-R-2000	0.0	0.0	100.0	0.0
MATT-210-R-2000	17.6	11.7	62.4	9.0
MATT-212-R-2000	1.4	25.8	72.5	1.0
MATT-216-R-2000	18.7	10.5	61.9	9.6
MATT-320-R-2000	10.4	20.1	63.5	6.5

Interpretation of Watershed Condition

- Generally good condition
- Most sites have low ANC values
- Chloride values are high, nitrite and ammonia concentrations somewhat high
- Site 103 tidally influenced
- Site 104 small stream, shallow with little cover from 0 to 50 m of segment; top 25 m optimal to sub-optimal habitat
- Sites 105 and 108 flow through many crop fields
- Site 115 has no riffles, suburban development, beaver dam in segment;
- Site 117 very small stream that runs through a pine plantation with a clearcut nearby
- Sites 212 and 216 are located by busy roads
- Site 320 includes beaver dam, stream braided over middle 25-m of segment

Mattawoman Creek

Water Chemistry Information

Site	Closed pH	Specific Cond.	ANC (ueq/L)	Cl (mg/L)	Nitrate-N (mg/L)	SO4 (mg/L)	P-P (mg/L)	TD-P (mg/L)	Ortho-P (mg/L)	Nitrite (mg/L)	Ammonia (mg/L)	TD-N (mg/L)	P-N (mg/L)	P-C (mg/L)	DOC (mg/L)	DO (mg/L)	Turbidity (NTUs)
MATT-103-R-2000	6.69	226.6	384.0	45.655	0.009	12.359	0.012	0.014	0.003	0.009	0.042	0.358	0.082	0.645	6.145	NS	NS
MATT-104-R-2000	6.61	80.5	120.5	10.128	0.054	11.727	0.003	0.010	0.003	0.008	0.011	0.142	0.010	0.161	1.834	6.8	3.3
MATT-105-R-2000	5.40	134.1	19.8	31.595	0.162	7.846	0.005	0.006	0.001	0.006	0.029	0.376	0.017	0.562	2.847	7.3	9.3
MATT-108-R-2000	5.99	119.7	39.1	26.216	0.165	9.272	0.004	0.009	0.001	0.006	0.019	0.218	0.007	0.433	2.923	7.1	8.3
MATT-109-R-2000	7.05	270.3	354.1	58.418	0.333	9.677	0.004	0.013	0.004	0.014	0.051	0.691	0.045	0.876	5.442	6.7	18.9
MATT-115-R-2000	6.38	305.8	484.3	64.199	0.279	7.572	0.013	0.053	0.003	0.013	0.292	0.796	0.025	0.807	8.842	5.3	15.4
MATT-117-R-2000	5.66	29.9	57.4	3.152	0.101	3.222	0.002	0.006	0.001	0.005	0.016	0.322	0.015	0.717	1.804	6.9	11.7
MATT-210-R-2000	6.58	255.5	131.3	58.734	0.259	11.241	0.005	0.014	0.004	0.009	0.049	0.476	0.031	0.355	3.240	7.0	8.9
MATT-212-R-2000	7.03	104.8	344.8	12.183	0.188	8.856	0.002	0.006	0.000	0.007	0.020	0.314	0.003	0.294	2.325	6.6	8.5
MATT-216-R-2000	6.35	270.9	134.1	62.093	0.271	11.010	0.010	0.008	0.003	0.012	0.051	0.555	0.033	0.387	4.679	7.0	8.6
MATT-320-R-2000	6.60	98.9	182.3	16.861	0.082	8.217	0.018	0.025	0.000	0.000	0.090	0.663	0.245	2.222	9.655	6.9	7.9

Physical Habitat Condition

Site	Riparian Buffer Width Left	Riparian Buffer Width Right	Adjacent Cover Left	Adjacent Cover Right	Instream Habitat Structure	Epifaunal Substrate	Velocity/Depth Diversity	Pool/Glide / Eddy Quality	Extent of Pools (m)	Riffle Run Quality	Extent of Riffles (m)	Embedded-ness	Shading	Trash Rating	Maximum Depth (cm)
MATT-103-R-2000	50	50	FR	FR	NS	NS	NS	NS	NS	NS	NS	NS	NS	13	NS
MATT-104-R-2000	16	50	PV	FR	11	9	6	8	65	6	12	85	90	19	40
MATT-105-R-2000	50	50	CP	LO	18	17	15	19	65	10	10	30	90	20	88
MATT-108-R-2000	7	5	CP	CP	19	17	17	17	40	16	40	35	80	19	82
MATT-109-R-2000	50	50	FR	HO	13	16	14	11	65	11	15	40	95	18	54
MATT-115-R-2000	38	10	PV	PV	19	13	6	19	75	0	0	45	95	15	87
MATT-117-R-2000	50	20	FR	LO	8	6	7	6	60	6	20	85	95	19	48
MATT-210-R-2000	50	50	FR	FR	17	10	13	16	70	11	5	15	93	16	93
MATT-212-R-2000	50	50	FR	FR	16	13	11	16	70	11	10	40	75	17	64
MATT-216-R-2000	32	50	PV	FR	17	12	15	18	70	11	10	20	65	13	105
MATT-320-R-2000	50	50	FR	FR	18	15	13	15	75	7	10	50	70	18	58

Physical Habitat Modifications

Site	Buffer Breaks?	Surface Mine?	Landfill?	Channelization?	Erosion Severity Left	Erosion Severity Right	Bar Formation
MATT-103-R-2000	N	N	N	N	NS	NS	NS
MATT-104-R-2000	N	N	N	N	Mild	Mild	Severe
MATT-105-R-2000	N	N	N	N	Mild	Mild	Moderate
MATT-108-R-2000	N	N	N	N	None	Mild	Minor
MATT-109-R-2000	N	N	N	N	None	Mild	Minor
MATT-115-R-2000	N	N	N	N	None	None	None
MATT-117-R-2000	N	N	N	N	None	Mild	None
MATT-210-R-2000	N	N	N	N	Mild	Mild	Severe
MATT-212-R-2000	N	N	N	N	None	Severe	Moderate
MATT-216-R-2000	N	N	N	N	Moderate	Moderate	Moderate
MATT-320-R-2000	N	N	N	N	Mild	Mild	Minor

Mattawoman Creek

Fish Species Present

AMERICAN EEL
BLACK CRAPPIE
BLACKNOSE DACE
BLUEGILL
BLUESPOTTED SUNFISH
BROWN BULLHEAD
CHAIN PICKEREL
CREEK CHUB
CREEK CHUBSUCKER
EASTERN MUDMINNOW
FALLFISH
GOLDEN SHINER
GREEN SUNFISH
LARGEMOUTH BASS
LEAST BROOK LAMPREY
MARGINED MADTOM
PUMPKINSEED
REDBREAST SUNFISH
REDFIN PICKEREL
ROSYIDE DACE
SEA LAMPREY
TESSELLATED DARTER
WARMOUTH
WHITE SUCKER
YELLOW BULLHEAD

Exotic Plants Present

JAPANESE HONEYSUCKLE
MULTIFLORA ROSE
THISTLE

Benthic Taxa Present

ABLABESMYIA
ACENTRELLA
ACERPENNA
AMELETUS
AMPHINEMURA
APSECTROTANYPUS
ATTENELLA
BRILLIA
CAMBARIDAE
CAPNIIDAE
CERATOPOGONIDAE
CHLOROPERLIDAE
COENAGRIONIDAE
COLLEMBOLA
CRANGONYCTIDAE
CAECIDOTEA
CALOPTERYX
CERATOPOGON
CHEUMATOPSYCHE
CLIOPERLA
CONCHAPELOPIA
CORYNONEURA
CRICOTOPUS
CRICOTOPUS/ORTHOCLADIUS
CRYPTOCHIRONOMUS
DICRANOTA
DICROTENDIPES
DIPLECTRONA
DIPLOCLADIUS
DOLOPHIODES
DUBIRAPHIA
DUGESIA
ECCOPTURA
ENDOCHIRONOMUS
EPHEMERELLA
EUKIEFFERIELLA
EURYLOPHELLA
FERRISSIA
GOMPHIDAE
GORDIIDAE
GAMMARUS
HEPTAGENIIDAE
HYDROBIIDAE
HABROPHLEBIA
HELICHUS
HYDROBAENUS
HYDROPORUS

HYDROPSYCHE
ISOPERLA
KRENOPELOPIA

LEPTOPHLEBIIDAE
LEUCTRIDAE
LIBELLULIDAE
LIMNEPHILIDAE
LACCOPHILUS
LARSIA
LEPIDOSTOMA
LEPTOPHLEBIA
LEUCTRA
LYPE
MENETUS
MEROPELOPIA
MICROPSECTRA
MICROTENDIPES
MICROVELIA
NAIDIDAE
NEMOURIDAE
NANOCLADIUS
NEOPHYLAX
ORTHOCLADIINAE
ORTHOCLADIINAE A
OULIMNIUS
PERLIDAE
PERLODIDAE
PHILOPOTAMIDAE
PALAEMONETES
PARACHAETOCCLADIUS
PARALEPTOPHLEBIA
PARAMETRIOCNEMUS
PARASMITTIA
PARATANYTARSUS
PARATENDIPES
PERLESTA
PISIDIUM
POLYPEDILUM
PROCAMBARUS
PROSIMULIUM
PROSTOIA
PROSTOMA
PSEPHENUS
PSEUDORTHOCLADIUS
PTILOSTOMIS
PTYCHOPTERA
RHEOCRICOTOPUS
RHEOTANYTARSUS
RHYACOPHILA
SIMULIIDAE
SIALIS

SIMULIUM
SIPHONURUS
STEGOPTERNA

STEMPELLINELLA
STENELMIS
STENONEMA
STROPHOPTERYX
SYNURELLA
TAENIOPTERYGIDAE
TANYPODINAE
TANYTARSINI
TUBIFICIDAE
TABANUS
TANYTARSUS
THIENEMANNIELLA
TIPULA
TRIBELOS
UNNIELLA
ZAVRELIMYIA

Herpetofauna Present

BULLFROG
GREEN FROG
NORTHERN DUSKY SALAMANDER
NORTHERN TWO-LINED SALAMANDER
NORTHERN WATER SNAKE
PICKEREL FROG
RED SALAMANDER
SOUTHERN LEOPARD FROG

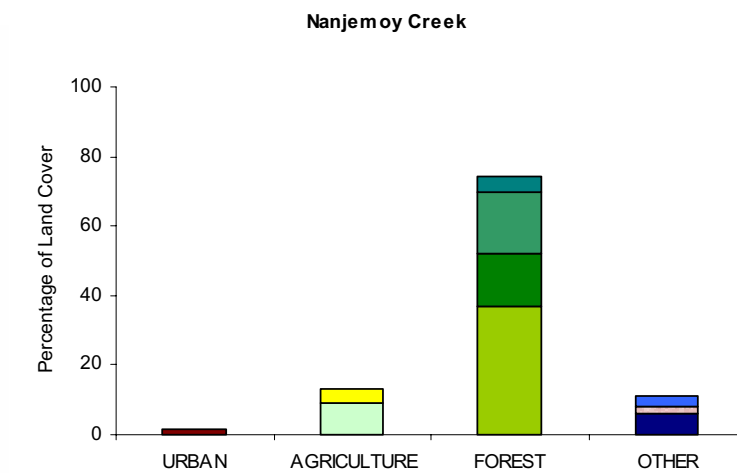
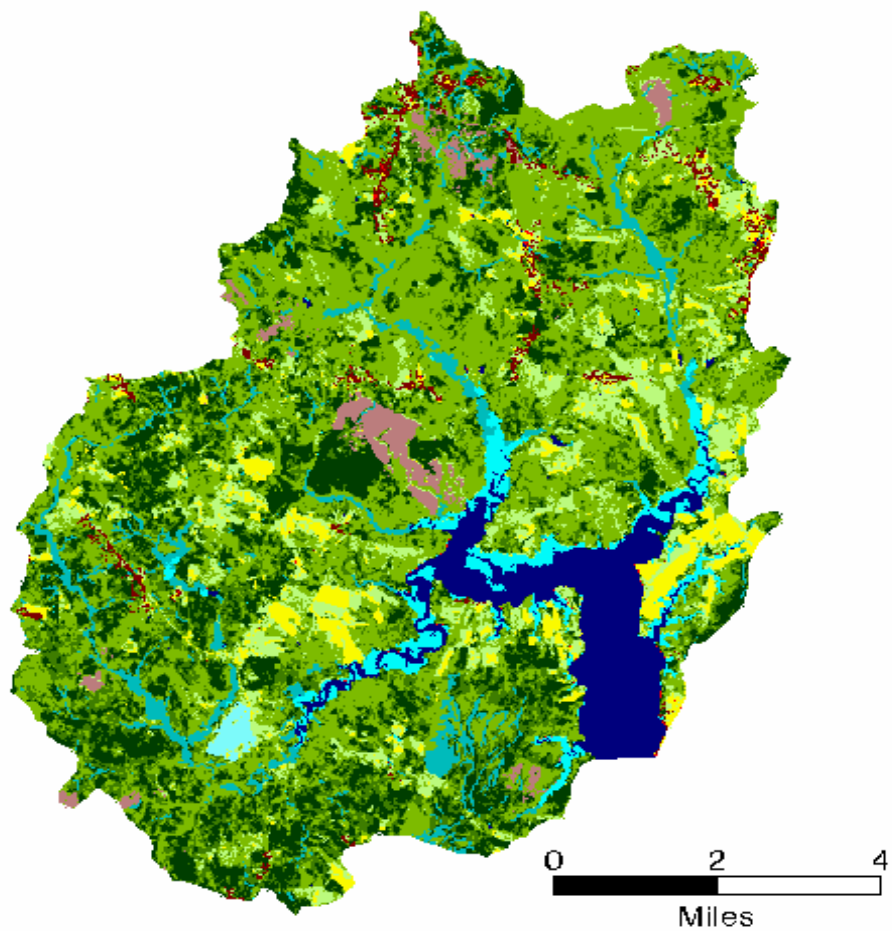


Nanjemoy Creek watershed
MBSS 2000



Watershed	Total Land Area (acres)	Total Stream Miles
Nanjemoy Creek	49323	86.3

Nanjemoy Creek



Nanjemoy Creek

Site Information

Site	Stream Name	12-digit Subwatershed Code	8-digit Watershed	Basin	County	Date Sampled Spring	Date Sampled Summer	Order	Catchment Area (acres)
NANJ-104-R-2000	MILL RUN UT1	021401100779	Nanjemoy CR	LOWER POTOMAC RIVER	Charles	03/08/00	06/14/00	1	554
NANJ-109-R-2000	NANJEMOY CR UT1	021401100776	Nanjemoy CR	LOWER POTOMAC RIVER	Charles	03/06/00	06/14/00	1	287
NANJ-111-R-2000	MILL RUN UT1	021401100779	Nanjemoy CR	LOWER POTOMAC RIVER	Charles	03/08/00	06/14/00	1	291
NANJ-112-R-2000	HANCOCK RUN	021401100777	Nanjemoy CR	LOWER POTOMAC RIVER	Charles	03/08/00	06/15/00	1	1318
NANJ-115-R-2000	HILL TOP FORK UT1	021401100775	Nanjemoy CR	LOWER POTOMAC RIVER	Charles	03/08/00	06/15/00	1	876
NANJ-117-R-2000	NANJEMOY CR UT1	021401100776	Nanjemoy CR	LOWER POTOMAC RIVER	Charles	03/06/00	06/14/00	1	492
NANJ-119-R-2000	JANE BERRYS RUN UT1	021401100778	Nanjemoy CR	LOWER POTOMAC RIVER	Charles	03/08/00	06/20/00	1	265
NANJ-205-R-2000	HANCOCK RUN	021401100777	Nanjemoy CR	LOWER POTOMAC RIVER	Charles	03/06/00	06/20/00	2	3626
NANJ-206-R-2000	BEAVERDAM CR	021401100777	Nanjemoy CR	LOWER POTOMAC RIVER	Charles	03/06/00	06/20/00	2	2654
NANJ-308-R-2000	NANJEMOY CR	021401100777	Nanjemoy CR	LOWER POTOMAC RIVER	Charles	03/06/00	08/24/00	3	10468

Indicator Information

Site	FIBI	BIBI	PHI	Brook Trout Present	Black Water Stream
NANJ-104-R-2000	3.50	3.29	58.94	0	0
NANJ-109-R-2000	NR	1.00	9.44	0	0
NANJ-111-R-2000	NR	3.86	42.00	0	0
NANJ-112-R-2000	2.50	3.29	71.31	0	0
NANJ-115-R-2000	3.75	3.00	94.35	0	0
NANJ-117-R-2000	1.00	1.00	5.22	0	0
NANJ-119-R-2000	NR	3.57	76.40	0	0
NANJ-205-R-2000	NR	1.86	92.47	0	1
NANJ-206-R-2000	1.50	2.43	88.54	0	0
NANJ-308-R-2000	3.50	2.71	83.42	0	1

Catchment Land Use Information

Site	Percent Urban	Percent Agriculture	Percent Forest	Percent Other
NANJ-104-R-2000	4.8	12.5	82.6	0.1
NANJ-109-R-2000	2.5	13.3	84.2	0.1
NANJ-111-R-2000	8.9	9.0	82.0	0.2
NANJ-112-R-2000	0.9	18.9	80.1	0.1
NANJ-115-R-2000	1.8	4.9	77.5	15.7
NANJ-117-R-2000	1.5	20.2	78.3	0.1
NANJ-119-R-2000	0.0	3.2	88.8	8.0
NANJ-205-R-2000	1.0	16.3	82.1	0.8
NANJ-206-R-2000	3.2	10.7	85.9	0.1
NANJ-308-R-2000	1.2	9.3	87.6	2.0

Interpretation of Watershed Condition

- ANC values are low; blackwater stream features were noted at several (Sites 112, 115, 205, 308)
- Sites 109 very small; nearly dry in summer (30 m of segment dry) with no flow, all standing water
- Stream intermittent between sites 109 and 117; Site 117 likely dry during summer, no flow observed during summer sampling
- A paved road crosses the stream at Site 112
- Clearcuts in a pine plantation are in the vicinity of Sites 115 and 117
- Beaver dam within Site 205
- Site 308 is Nature Conservancy land

Nanjemoy Creek

Water Chemistry Information

Site	Closed pH	Specific Cond.	ANC (ueq/L)	Cl (mg/L)	Nitrate-N (mg/L)	SO4 (mg/L)	P-P (mg/L)	TD-P (mg/L)	Ortho-P (mg/L)	Nitrite (mg/L)	Ammonia (mg/L)	TD-N (mg/L)	P-N (mg/L)	P-C (mg/L)	DOC (mg/L)	DO (mg/L)	Turbidity (NTUs)
NANJ-104-R-2000	6.00	58.9	40.8	5.930	0.000	10.792	0.001	0.008	0.001	0.005	0.006	0.025	0.013	0.276	1.648	6.8	3
NANJ-109-R-2000	4.82	31.9	2.1	3.658	0.000	3.980	0.001	0.010	0.003	0.008	0.020	0.125	0.008	0.445	3.604	2.5	10.1
NANJ-111-R-2000	5.55	44.5	17.7	7.421	0.000	4.750	0.002	0.010	0.003	0.007	0.010	0.070	0.010	0.195	1.901	7.5	3.5
NANJ-112-R-2000	5.47	71.9	23.4	12.718	0.227	6.741	0.003	0.007	0.000	0.006	0.041	0.407	0.011	0.921	4.516	6.7	12.4
NANJ-115-R-2000	6.09	42.4	54.4	6.548	0.036	3.465	0.002	0.007	0.000	0.005	0.015	0.111	0.024	0.763	2.811	7.8	7.6
NANJ-117-R-2000	4.86	41.0	12.1	2.948	0.000	6.825	0.007	0.006	0.003	0.008	0.013	0.183	0.033	0.893	6.550	1.2	7.2
NANJ-119-R-2000	5.38	24.0	19.4	3.427	0.026	1.724	0.002	0.007	0.001	0.007	0.013	0.073	0.210	4.465	3.482	6.0	6.3
NANJ-205-R-2000	5.71	87.3	93.1	18.084	0.000	5.105	0.008	0.014	0.003	0.009	0.018	0.480	0.058	2.221	10.288	5.5	26.5
NANJ-206-R-2000	5.30	81.4	18.0	18.031	0.000	4.076	0.003	0.012	0.003	0.008	0.017	0.318	0.029	0.780	7.906	4.5	18.7
NANJ-308-R-2000	6.31	78.9	103.4	14.188	0.000	5.094	0.004	0.009	0.004	0.009	0.015	0.425	0.037	0.600	14.126	5.4	13

Physical Habitat Condition

Site	Riparian Buffer Width Left	Riparian Buffer Width Right	Adjacent Cover Left	Adjacent Cover Right	Instream Habitat Structure	Epifaunal Substrate	Velocity/ Depth Diversity	Pool/Glide/ Eddy Quality	Extent of Pools (m)	Riffle Run Quality	Extent of Riffles (m)	Embedded-ness	Shading	Trash Rating	Maximum Depth (cm)
NANJ-104-R-2000	5	50	TG	FR	12	14	8	9	65	8	15	25	95	18	37
NANJ-109-R-2000	50	50	FR	FR	5	5	3	6	45	0	0	100	98	19	20
NANJ-111-R-2000	50	50	LN	FR	10	11	6	8	65	4	15	40	95	19	36
NANJ-112-R-2000	50	50	LN	FR	16	14	12	15	75	6	2	85	65	6	68
NANJ-115-R-2000	50	50	FR	FR	17	11	14	18	55	11	20	35	80	19	66
NANJ-117-R-2000	16	36	LO	LO	3	4	2	3	70	0	0	100	95	20	17
NANJ-119-R-2000	50	50	FR	FR	16	16	10	10	70	13	15	30	95	20	37
NANJ-205-R-2000	50	50	FR	FR	19	18	10	19	75	0	0	95	40	18	113
NANJ-206-R-2000	50	50	FR	FR	16	15	12	18	75	4	3	75	85	15	86
NANJ-308-R-2000	50	50	FR	FR	16	11	10	14	60	12	20	35	85	20	42

Physical Habitat Modifications

Site	Buffer Breaks?	Surface Mine?	Landfill?	Channelization?	Erosion Severity Left	Erosion Severity Right	Bar Formation
NANJ-104-R-2000	N	N	N	N	Moderate	Moderate	Severe
NANJ-109-R-2000	N	N	N	N	None	None	None
NANJ-111-R-2000	N	N	N	N	Moderate	Moderate	Moderate
NANJ-112-R-2000	Y	N	N	Y	Moderate	Moderate	Moderate
NANJ-115-R-2000	N	N	N	N	Severe	Severe	Moderate
NANJ-117-R-2000	N	N	N	N	None	None	None
NANJ-119-R-2000	N	N	N	N	None	None	Minor
NANJ-205-R-2000	N	N	N	N	None	None	None
NANJ-206-R-2000	N	N	N	N	None	Moderate	None
NANJ-308-R-2000	N	N	N	N	Moderate	Mild	Moderate

Nanjemoy Creek

Fish Species Present

AMERICAN EEL
BLACK CRAPPIE
BLACKNOSE DACE
BLUEGILL
BLUESPOTTED SUNFISH
CHAIN PICKEREL
CREEK CHUB
CREEK CHUBSUCKER
EASTERN MUDMINNOW
GOLDEN SHINER
LEAST BROOK LAMPREY
MARGINED MADTOM
PUMPKINSEED
REDBREAST SUNFISH
ROSYSIDE DACE
SEA LAMPREY
TESSELLATED DARTER
WHITE SUCKER

Exotic Plants Present

MULTIFLORA ROSE

Benthic Taxa Present

ACERPENNA
AMELETUS
AMPHINEMURA
APSECTROTANYPUS
BAETIDAE
CAPNIIDAE
CERATOPOGONIDAE
CHLOROPERLIDAE
CORIXIDAE
CRANGONYCTIDAE
CAECIDOTEA
CALOPTERYX
CHEUMATOPSYCHE
CHIRONOMUS
CLIOPERLA
CONCHAPELOPIA
CORYNONEURA
CRANGONYX
CRICOTOPUS
CRICOTOPUS/ORTHOCLADIUS
DYTISCIDAE
DICROTENDIPES
DIPLECTRONA
DIPLOCLADIUS
DOLOPHIODES
EPHEMERELLIDAE
ECCOPTURA
EUKIEFFERIELLA
EURYLOPHELLA
GOMPHIDAE
GAMMARUS
HEPTAGENIIDAE
HYDROPSYCHIDAE
HABROPHLEBIA
HELICHUS
HETEROTRISOCLADIUS
HEXATOMA
HYALELLA
HYDROPORUS
HYDROPSYCHE
IRONOQUIA
ISOPERLA
ISOTOMURUS
KRENOPELOPIA
LEUCTRIDAE
LIBELLULIDAE

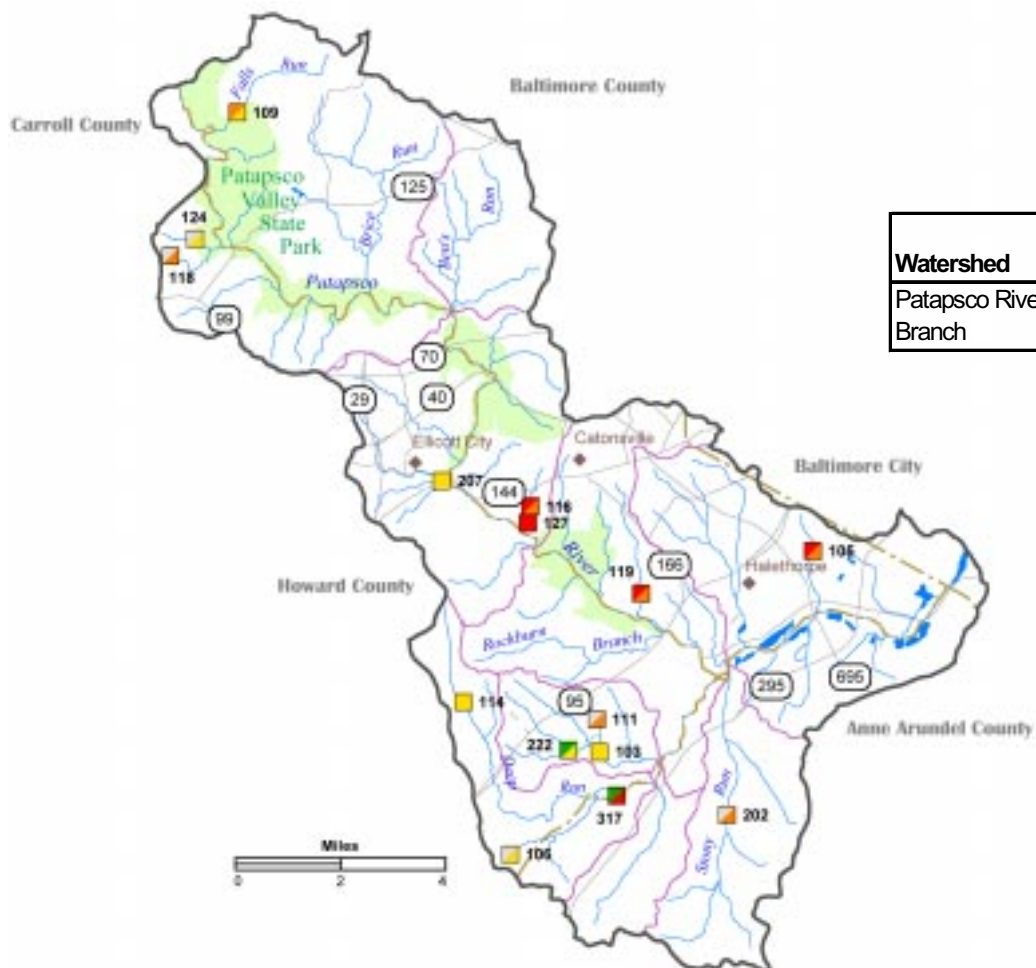
LUMBRICULIDAE
LARSIA
LEPTOPHLEBIA
LEUCTRA
MEROPELOPIA
NAIDIDAE
NEMOURIDAE
NEOPHYLAX
NIGRONIA
ORTHOCLADIINAE
OPTIOSERVUS
OULIMNIUS
PERLIDAE
PERLODIDAE
POLYCENTROPODIDAE
PARACHAETOCLADIUS
PARAMERINA
PARAMETRIOCNEMUS
PELTODYTES
POLYPEDILUM
PROBEZZIA
PROCLADIUS
PROSIMILIUM
PROSTOIA
PTILOSTOMIS
PYCNOPSYCHE
RHEOCRICOTOPUS
RHYACOPHILA
SPHAERIIDAE
SIALIS
SIMILIUM
STEGOPTERNA
STEMPELLINA
STENELMIS
STENONEMA
SYMPOSIOCLADIUS
SYNURELLA
TANYTARSINI
TIPULIDAE
TUBIFICIDAE
TANYTARSUS
THIENEMANNIELLA
TIPULA
TRISSOPELOPIA
UNNIELLA
ZAVRELIMYIA

Herpetofauna Present

AMERICAN TOAD
BULLFROG
EASTERN BOX TURTLE
GREEN FROG
NORTHERN FENCE LIZARD
NORTHERN TWO-LINED SALAMANDER
NORTHERN WATER SNAKE
PICKEREL FROG
RED SALAMANDER
WOOD FROG

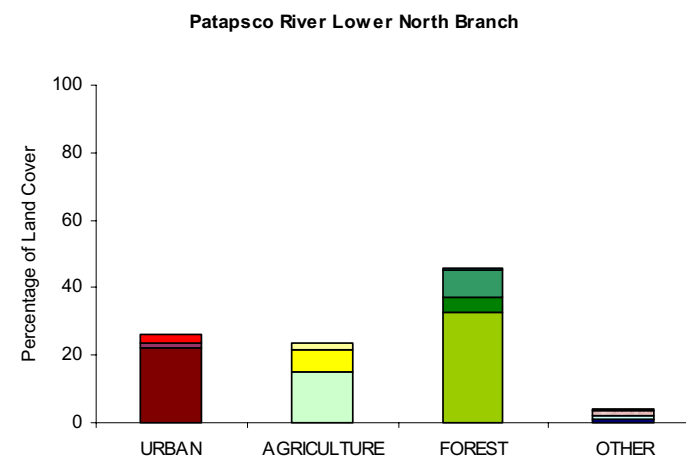
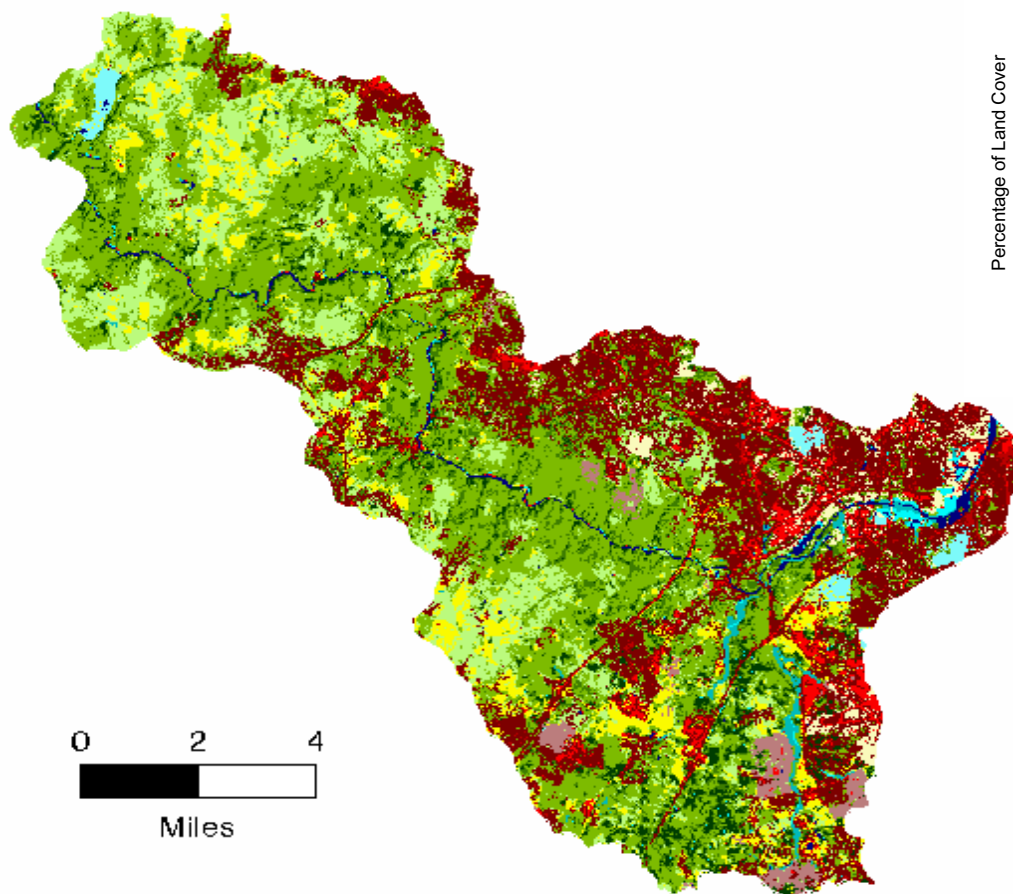


**Patapsco River Lower
North Branch watershed
MBSS 2000**



Watershed	Total Land Area (acres)	Total Stream Miles
Patapsco River Lower North Branch	75755	139.6

Patapsco River Lower North Branch



Patapsco River Lower North Branch

Site Information

Site	Stream Name	12-digit Subwatershed Code	8-digit Watershed	Basin	County	Date Sampled Spring	Date Sampled Summer	Order	Catchment Area (acres)
PATL-103-R-2000	DEEP RUN UT2	021309061015	Patapsco River L N Br	PATAPSCO RIVER	Howard	03/09/00	06/29/00	1	2243
PATL-105-R-2000	PATAPSCOR UT2	021309061012	Patapsco River L N Br	PATAPSCO RIVER	Baltimore	03/08/00	07/10/00	1	313
PATL-106-R-2000	DEEP RUN UT1	021309061014	Patapsco River L N Br	PATAPSCO RIVER	Howard	03/15/00	07/06/00	1	74
PATL-109-R-2000	FALLS RUN	021309061019	Patapsco River L N Br	PATAPSCO RIVER	Baltimore	03/07/00	07/12/00	1	2018
PATL-111-R-2000	DEEP RUN UT2	021309061015	Patapsco River L N Br	PATAPSCO RIVER	Howard	03/09/00	06/22/00	1	201
PATL-114-R-2000	DEEP RUN	021309061014	Patapsco River L N Br	PATAPSCO RIVER	Howard	03/09/00	07/06/00	1	794
PATL-116-R-2000	PATAPSCOR UT1	021309061017	Patapsco River L N Br	PATAPSCO RIVER	Baltimore	03/08/00	06/22/00	1	406
PATL-118-R-2000	PATAPSCOR UT3	021309061019	Patapsco River L N Br	PATAPSCO RIVER	Howard	03/07/00	07/12/00	1	29
PATL-119-R-2000	SOAPSTONE BR	021309061016	Patapsco River L N Br	PATAPSCO RIVER	Baltimore	03/08/00	07/10/00	1	986
PATL-124-R-2000	PATAPSCOR UT3	021309061019	Patapsco River L N Br	PATAPSCO RIVER	Howard	03/07/00	07/12/00	1	240
PATL-127-R-2000	PATAPSCOR UT1	021309061017	Patapsco River L N Br	PATAPSCO RIVER	Baltimore	03/08/00	06/22/00	1	689
PATL-202-R-2000	STONE RUN	021309061011	Patapsco River L N Br	PATAPSCO RIVER	Anne Arundel	03/13/00	NS	2	3505
PATL-207-R-2000	TIBER RUN	021309061017	Patapsco River L N Br	PATAPSCO RIVER	Howard	03/08/00	06/22/00	2	1389
PATL-222-R-2000	DEEP RUN UT2 UT1	021309061015	Patapsco River L N Br	PATAPSCO RIVER	Howard	03/09/00	06/29/00	2	1166
PATL-317-R-2000	DEEP RUN	021309061014	Patapsco River L N Br	PATAPSCO RIVER	Howard, Anne Arundel	03/15/00	07/06/00	3	5194

Indicator Information

Site	FIBI	BIBI	PHI	Brook Trout Present	Black Water Stream
PATL-103-R-2000	3.67	3.00	60.24	0	0
PATL-105-R-2000	1.67	2.56	60.92	0	0
PATL-106-R-2000	NR	3.00	86.96	0	0
PATL-109-R-2000	2.56	3.22	25.92	0	0
PATL-111-R-2000	NR	2.56	50.35	0	0
PATL-114-R-2000	3.22	3.67	93.68	0	0
PATL-116-R-2000	1.22	2.56	58.76	0	0
PATL-118-R-2000	NS	2.78	NS	NS	NS
PATL-119-R-2000	1.22	2.33	50.87	0	0
PATL-124-R-2000	NR	3.67	95.69	0	0
PATL-127-R-2000	1.22	1.89	91.75	0	0
PATL-202-R-2000	NS	2.43	NS	NS	NS
PATL-207-R-2000	3.00	3.44	53.93	0	0
PATL-222-R-2000	4.11	3.67	92.77	0	0
PATL-317-R-2000	4.56	1.89	78.78	0	0

Catchment Land Use Information

Site	Percent Urban	Percent Agriculture	Percent Forest	Percent Other
PATL-103-R-2000	27.3	22.3	45.1	5.5
PATL-105-R-2000	52.4	10.3	18.8	18.6
PATL-106-R-2000	54.0	6.0	40.0	0.0
PATL-109-R-2000	3.3	44.1	44.1	8.8
PATL-111-R-2000	73.6	2.7	23.7	0.0
PATL-114-R-2000	11.0	76.0	13.0	0.0
PATL-116-R-2000	61.4	4.8	33.8	0.0
PATL-118-R-2000	13.3	26.7	60.0	0.0
PATL-119-R-2000	47.5	10.7	36.3	5.6
PATL-124-R-2000	0.8	53.9	45.3	0.0
PATL-127-R-2000	39.0	8.7	52.3	0.0
PATL-202-R-2000	34.2	19.5	27.0	19.8
PATL-207-R-2000	36.9	24.9	38.2	0.1
PATL-222-R-2000	17.8	21.3	50.7	10.4
PATL-317-R-2000	23.1	33.0	43.2	0.9

Interpretation of Watershed Condition

- Extensive urban development. Most sites show impacts of urban development and runoff from impervious surfaces: erosion, flashiness, siltation
- Nitrogen concentrations are high, and most sites also have elevated chloride levels
- Site 106 in good condition, not directly impacted but very small stream
- Site 103 extremely bad erosion, frequent flooding, downstream from development. Flow very low although channel huge; evidence of high storm flows. Fish IBI likely inflated by presence of young-of-year; not many adult fish at site.
- Quarry discharges to Site 109.
- Site 116 very high gradient with sewage, algae, flashy flows, erosion
- Site 118 dry in summer
- Site 202 flooded from beaver dam (benthic sample taken 200 m below site because too deep to sample)
- Site 207 runs beneath Ellicott City, receives drainage from restaurants and homes, sewage suspected
- Site 317 receives industrial stormwater; floods frequently, beaver dam upstream

Patapsco River Lower North Branch

Water Chemistry Information

Site	Closed pH	Specific Cond.	ANC (ueq/L)	Cl (mg/L)	Nitrate-N (mg/L)	SO4 (mg/L)	P-P (mg/L)	TD-P (mg/L)	Ortho-P (mg/L)	Nitrite (mg/L)	Ammonia (mg/L)	TD-N (mg/L)	P-N (mg/L)	P-C (mg/L)	DOC (mg/L)	DO (mg/L)	Turbidity (NTUs)
PATL-103-R-2000	8.06	492.3	1522.7	73.780	0.345	22.266	0.002	0.004	0.003	0.009	0.012	0.559	0.020	0.307	1.016	7.3	5.2
PATL-105-R-2000	8.01	546.4	1638.6	81.331	1.326	33.864	0.009	0.006	0.000	0.022	0.081	1.586	0.034	0.328	2.040	6.4	22.3
PATL-106-R-2000	5.38	368.9	37.9	75.905	2.747	25.657	0.001	0.005	0.001	0.000	0.003	3.156	0.026	0.224	1.741	6.3	0.1
PATL-109-R-2000	7.84	207.7	662.9	27.062	1.870	13.676	0.001	0.283	0.003	0.010	0.013	2.024	0.000	0.097	1.425	8.7	5.4
PATL-111-R-2000	7.52	639.7	2344.9	76.588	0.377	26.603	0.003	0.005	0.000	0.010	0.021	0.490	0.007	0.216	2.705	6.2	5.2
PATL-114-R-2000	7.88	574.4	1666.4	76.633	1.477	19.909	0.003	0.010	0.005	0.009	0.017	1.651	0.021	0.187	1.822	7.8	2.7
PATL-116-R-2000	8.92	592.8	2591.5	71.113	0.878	35.395	0.004	0.009	0.005	0.009	0.017	1.033	0.039	0.378	2.418	8.0	2.2
PATL-118-R-2000	6.81	243.6	681.7	24.222	3.677	24.895	0.003	0.010	0.003	0.009	0.015	3.972	0.010	0.174	2.382	NS	NS
PATL-119-R-2000	8.39	378.6	1654.2	47.805	1.321	26.080	0.001	0.010	0.002	0.009	0.010	1.381	0.015	0.173	1.549	8.4	0
PATL-124-R-2000	7.40	175.9	365.7	16.814	2.410	23.071	0.002	0.016	0.015	0.009	0.009	2.520	0.002	0.166	1.197	9.0	0.8
PATL-127-R-2000	8.40	482.0	2136.1	63.049	0.619	33.804	0.001	0.006	0.004	0.010	0.007	0.695	0.019	0.127	1.818	8.7	1.8
PATL-202-R-2000	6.87	298.0	514.1	54.189	0.501	21.085	0.007	0.009	0.003	0.012	0.058	0.750	0.081	0.951	5.182	NS	NS
PATL-207-R-2000	8.05	729.9	2301.1	73.716	1.234	33.644	0.002	0.013	0.010	0.009	0.016	1.465	0.005	0.174	2.255	8.6	9.8
PATL-222-R-2000	7.73	610.4	1361.7	73.024	0.265	23.172	0.002	0.006	0.000	0.009	0.014	0.304	0.044	0.360	2.410	7.4	8.3
PATL-317-R-2000	7.58	489.6	1324.7	91.748	0.688	24.510	0.003	0.006	0.000	0.000	0.009	0.815	0.031	0.315	2.722	7.6	10.9

Physical Habitat Condition

Site	Riparian Buffer Width Left	Riparian Buffer Width Right	Adjacent Cover Left	Adjacent Cover Right	Instream Habitat Structure	Epifaunal Substrate	Velocity/ Depth Diversity	Pool/Glide/ Eddy Quality	Extent of Pools (m)	Riffle Run Quality	Extent of Riffles (m)	Embedded-ness	Shading	Trash Rating	Maximum Depth (cm)
PATL-103-R-2000	30	5	HO	HO	11	12	12	12	38	14	55	24	60	2	60
PATL-105-R-2000	50	15	PK	PK	13	11	12	13	73	7	5	35	85	3	58
PATL-106-R-2000	50	50	FR	FR	14	15	8	9	50	14	45	30	95	16	27
PATL-109-R-2000	20	35	QR	PV	6	5	7	7	65	6	25	60	90	13	27
PATL-111-R-2000	10	30	LN	LN	11	11	11	10	45	9	39	30	85	3	56
PATL-114-R-2000	50	50	PK	FR	17	12	11	11	60	14	35	35	70	10	59
PATL-116-R-2000	30	50	PV	FR	16	17	10	9	25	17	59	39	78	5	42
PATL-118-R-2000	50	10	FR	LN										19	
PATL-119-R-2000	40	50	PV	FR	17	18	7	8	35	16	65	35	85	14	45
PATL-124-R-2000	50	50	FR	FR	16	17	8	9	17	13	65	12	94	19	28
PATL-127-R-2000	50	20	FR	PV	19	15	17	18	35	15	55	35	87	3	115
PATL-202-R-2000	50	50	FR	FR										16	
PATL-207-R-2000	5	0	PK	PK	17	17	14	14	25	15	65	45	93	2	63
PATL-222-R-2000	50	50	PK	HO	16	16	16	16	55	13	45	30	65	5	126
PATL-317-R-2000	50	30	HO	RR	14	7	16	15	65	13	14	51	63	5	93

Patapsco River Lower North Branch

Physical Habitat Modifications

Site	Buffer Breaks?	Surface Mine?	Landfill?	Channelization?	Erosion Severity Left	Erosion Severity Right	Bar Formation
PATL-103-R-2000	Y	N	N	Y	Severe	None	Severe
PATL-105-R-2000	Y	N	N	Y	Moderate	Severe	Moderate
PATL-106-R-2000	N	N	N	N	Mild	Mild	Minor
PATL-109-R-2000	N	Y	N	N	Mild	Severe	Moderate
PATL-111-R-2000	N	N	N	N	Moderate	Moderate	Severe
PATL-114-R-2000	N	N	N	N	Moderate	Moderate	Moderate
PATL-116-R-2000	N	N	N	N	Severe	Severe	Severe
PATL-118-R-2000	N	N	N	N	NS	NS	NS
PATL-119-R-2000	N	N	N	Y	None	None	Severe
PATL-124-R-2000	N	N	N	N	Mild	Severe	Minor
PATL-127-R-2000	N	N	N	N	Mild	None	Severe
PATL-202-R-2000	N	N	N	N	NS	NS	NS
PATL-207-R-2000	Y	N	N	Y	None	None	Moderate
PATL-222-R-2000	N	N	N	Y	Mild	Mild	Moderate
PATL-317-R-2000	Y	N	N	Y	Severe	Severe	Moderate

Patapsco River Lower North Branch

Fish Species Present

AMERICAN EEL
BLACKNOSE DACE
BLUEGILL
BLUNTNOST MINNOW
CENTRAL STONEROLLER
COMMON SHINER
CREEK CHUB
CUTLIPS MINNOW
EASTERN MUDMINNOW
FALLFISH
FATHEAD MINNOW
GOLDEN SHINER
GREEN SUNFISH
LARGEMOUTH BASS
LEPOMIS HYBRID
LONGNOSE DACE
MOSQUITOFISH
MOTTLED SCULPIN
NORTHERN HOGSUCKER
PUMPKINSEED
REDBREAST SUNFISH
RIVER CHUB
ROSYIDE DACE
SMALLMOUTH BASS
SWALLOWTAIL SHINER
TESSELLATED DARTER
WHITE SUCKER

Exotic Plants Present

JAPANESE HONEYSUCKLE
MICROSTEGIUM
MULTIFLORA ROSE
THISTLE

Benthic Taxa Present

ALLOCAPNIA
AMELETUS
AMPHINEMURA
ANTOCHA
APSECTROTANYPUS
BAETIDAE
BRILLIA
CAPNIIDAE
CHLOROPERLIDAE
COLLEMBOLA
CAECIDOTEA
CERATOPOGON
CHEUMATOPSYCHE
CHIMARRA
CHRYSOPTERUS
CLINOCERA
CONCHAPELOPIA
CORDULEGASTER
CORYNONEURA
CRICOTOPUS
CRICOTOPUS/ORTHOCLADIUS
DIAMESINAE
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DIPLOCLADIUS
EPHEMERELLIDAE
ENDOCHIRONOMUS
EPEORUS
EPHEMERELLA
EUKIEFFERIELLA
EURYLOPHELLA
GOMPHIDAE
GORDIIDAE
HYDROPSYCHIDAE
HELIUS
HEMERODROMIA
HETEROTRISOCLADIUS
HEXATOMA
HYDROPSYCHE
ISOTOMURUS
KRENOPELOPIA
LUMBRICULIDAE
LYMNAEIDAE

LEUCTRA
LIMNAPHILUS
LIMNOPHYTES
MEROPELOPIA
MICROPECTRA
MOLANNA
NAIDIDAE
NEMATOMORPHA
NEMOURIDAE
NANOCLADIUS
NEOPHYLAX
ORTHOCLADIIDAE
OPTIOSERVUS
ORTHOCLADIIDAE A
OULIMNIUS
PARAMETRIOCNEMUS
PARAPHAENOCCLADIUS
PARATANYTARSUS
PHAENOPSECTRA
POLYPEDILUM
PROSIMULIUM
PROSTOIA
PSEPHENUS
RHEOCRICOTOPUS
RHEOTANYTARSUS
RHYACOPHILA
SIMULIIDAE
SIMULIUM
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STENELMIS
STENONEMA
STILOCLADIUS
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SYMPOTTHASTIA
TANYPODINAE
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ZAVRELIMYIA

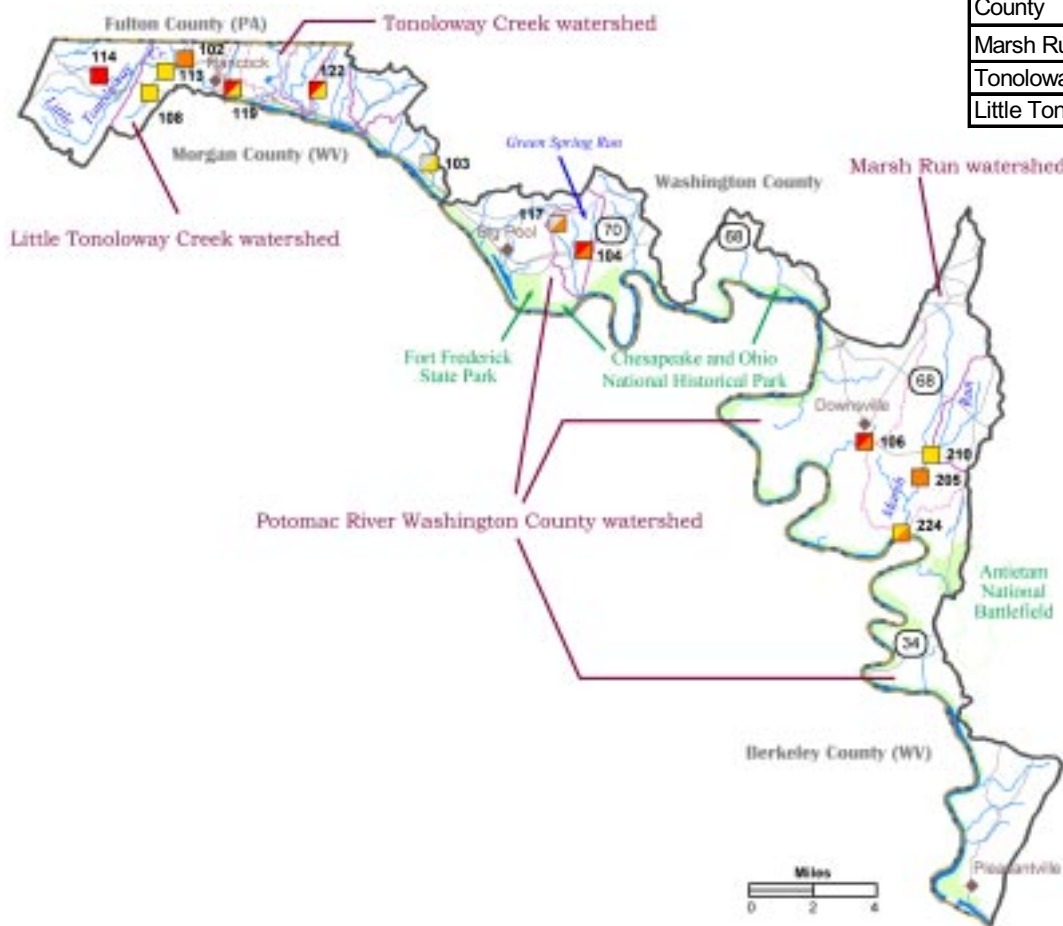
Herpetofauna Present

BULLFROG
EASTERN BOX TURTLE
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GREEN FROG
NORTHERN DUSKY SALAMANDER
NORTHERN TWO-LINED SALAMANDER
NORTHERN WATER SNAKE
PICKEREL FROG
RED SALAMANDER

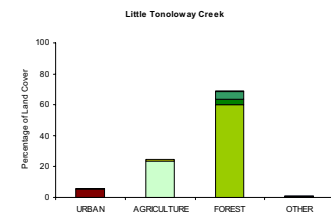
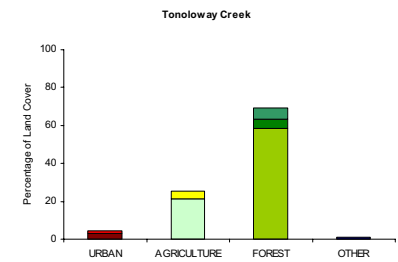
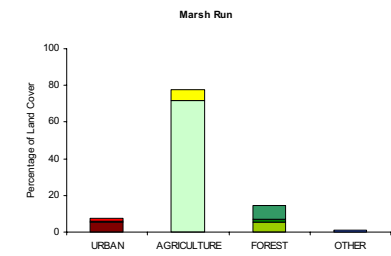
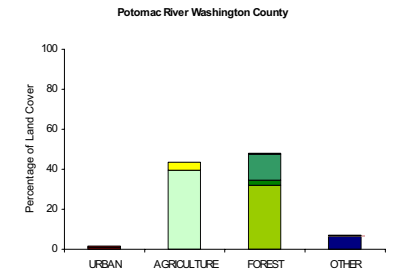
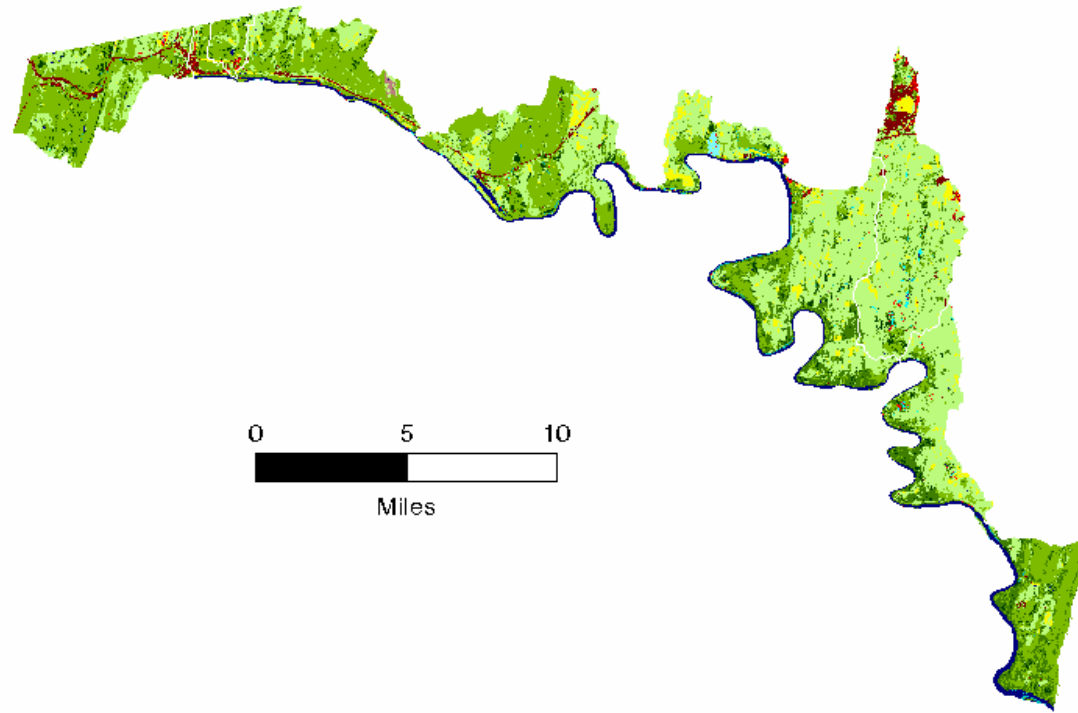


**Potomac River Washington County/
Marsh Run/ Tonoloway Creek/
Little Tonoloway Creek watersheds
MBSS 2000**

Watershed	Total Land Area (acres)	Total Stream Miles
Potomac River Washington County	58297	65.8
Marsh Run	13460	15.61
Tonoloway Creek	1338	3.2
Little Tonoloway Creek	9885	22.2



Potomac River WA Co/Marsh Run/Tonoloway/Little Tonoloway



Potomac River WA Co/Marsh Run/Tonoloway/Little Tonoloway

Site Information

Site	Stream Name	12-digit Subwatershed Code	8-digit Watershed	Basin	County	Date Sampled Spring	Date Sampled Summer	Order	Catchment Area (acres)
LTON-102-R-2000	LITTLE TONOLOWAY CR UT2	021405090154	Little Tonoloway CR	UPPER POTOMAC RIVER	Washington	03/30/00	08/03/00	1	645
LTON-108-R-2000	LITTLE TONOLOWAY CR UT1	021405090154	Little Tonoloway CR	UPPER POTOMAC RIVER	Washington	03/30/00	08/09/00	1	801
LTON-113-R-2000	LITTLE TONOLOWAY CR UT1	021405090154	Little Tonoloway CR	UPPER POTOMAC RIVER	Washington	03/30/00	08/09/00	1	1264
LTON-114-R-2000	MUNSON SPRING BR	021405090153	Little Tonoloway CR	UPPER POTOMAC RIVER	Washington	04/03/00	08/03/00	1	599
MARS-205-R-2000	MARSH RUN	021405030185	Marsh Run	UPPER POTOMAC RIVER	Washington	03/29/00	07/07/00	2	10333
MARS-210-R-2000	MARSH RUN	021405030186	Marsh Run	UPPER POTOMAC RIVER	Washington	03/29/00	08/29/00	2	3106
MARS-224-R-2000	MARSH RUN	021405030185	Marsh Run	UPPER POTOMAC RIVER	Washington	04/10/00	08/29/00	2	13459
PRWA-103-R-2000	POTOMAC RIVER UT2	021405010160	Potomac River WA Cnty	UPPER POTOMAC RIVER	Washington	03/30/00	08/09/00	1	242
PRWA-104-R-2000	GREEN SPRING RUN UT1	021405010162	Potomac River WA Cnty	UPPER POTOMAC RIVER	Washington	03/30/00	08/09/00	1	623
PRWA-106-R-2000	DOWNEY BR	021405010165	Potomac River WA Cnty	UPPER POTOMAC RIVER	Washington	03/29/00	08/29/00	1	1370
PRWA-117-R-2000	GREEN SPRING RUN	021405010162	Potomac River WA Cnty	UPPER POTOMAC RIVER	Washington	03/30/00	06/29/00	1	65
PRWA-119-R-2000	POTOMAC RIVER UT3	021405010155	Potomac River WA Cnty	UPPER POTOMAC RIVER	Washington	03/30/00	08/03/00	1	537
PRWA-122-R-2000	POTOMAC RIVER UT5	021405010158	Potomac River WA Cnty	UPPER POTOMAC RIVER	Washington	03/30/00	08/09/00	1	541

Indicator Information

Site	FIBI	BIBI	PHI	Brook Trout Present	Black Water Stream
LTON-102-R-2000	2.43	2.56	97.05	0	0
LTON-108-R-2000	3.00	3.22	34.05	0	0
LTON-113-R-2000	3.00	3.22	52.91	0	0
LTON-114-R-2000	1.00	1.89	84.72	0	0
MARS-205-R-2000	2.71	2.11	36.38	0	0
MARS-210-R-2000	3.00	3.44	99.78	0	0
MARS-224-R-2000	3.29	2.33	96.26	0	0
PRWA-103-R-2000	NR	3.44	9.65	0	0
PRWA-104-R-2000	1.00	2.78	49.33	0	0
PRWA-106-R-2000	1.00	2.56	55.95	0	0
PRWA-117-R-2000	NS	2.56	NS	NS	NS
PRWA-119-R-2000	1.29	3.00	24.76	0	0
PRWA-122-R-2000	1.57	3.22	95.45	0	0

Catchment Land Use Information

Site	Percent Urban	Percent Agriculture	Percent Forest	Percent Other
LTON-102-R-2000	2.3	65.7	31.0	1.3
LTON-108-R-2000	0.1	39.8	60.1	0.9
LTON-113-R-2000	0.1	45.2	54.7	0.6
LTON-114-R-2000	14.7	21.9	63.2	0.5
MARS-205-R-2000	9.3	76.8	13.4	0.4
MARS-210-R-2000	3.8	83.8	11.9	0.7
MARS-224-R-2000	7.4	77.4	14.5	0.8
PRWA-103-R-2000	0.0	31.0	35.5	34.8
PRWA-104-R-2000	2.3	7.1	90.6	0.2
PRWA-106-R-2000	1.2	93.2	5.5	0.2
PRWA-117-R-2000	0.0	5.3	94.7	0.0
PRWA-119-R-2000	6.9	27.2	65.9	0.1
PRWA-122-R-2000	0.1	59.4	40.5	0.5

Interpretation of Watershed Condition

- At many sites, ANC values very high
- Marsh Run Sites (205, 210, 224) had high pH, high ANC that are typical of limestone streams, high nutrients that are typical of agricultural areas, but low populations of fish and benthic invertebrates. Site 205 mostly clay bottom.
- Sulfate and chloride concentrations are high and several sites, nitrogen and phosphorus concentrations are high at some
- Some sites had high percentage agricultural land in catchment
- Recent logging at Site 103
- Site 104 between the east and west bound lanes of I-70; heavy silt deposition, very little flow, all fish very small, probably all young-of-year
- Site 114 had white precipitate build-up on sediments in spring and orange in summer
- Site 117 very small, dry in summer. Flows through sheep pasture
- Site 119 very small, shallow, (mostly less than 10 cm deep)
- Site 122 may have been dry the week prior to summer sampling

Potomac River WA Co/Marsh Run/Tonoloway/Little Tonoloway

Water Chemistry Information

Site	Closed pH	Specific Cond.	ANC (ueq/L)	Cl (mg/L)	Nitrate-N (mg/L)	SO4 (mg/L)	P-P (mg/L)	TD-P (mg/L)	Ortho-P (mg/L)	Nitrite (mg/L)	Ammonia (mg/L)	TD-N (mg/L)	P-N (mg/L)	P-C (mg/L)	DOC (mg/L)	DO (mg/L)	Turbidity (NTUs)
LTON-102-R-2000	8.05	408.0	3933.0	1.798	0.482	54.401	0.000	0.006	0.000	0.000	0.000	0.624	0.010	0.107	1.575	8.4	5.7
LTON-108-R-2000	8.11	401.4	3467.6	18.090	0.483	19.937	0.001	0.006	0.000	0.000	0.001	0.687	0.040	0.334	2.735	7.2	3.3
LTON-113-R-2000	8.28	400.1	3870.7	23.285	0.351	21.501	0.001	0.005	0.001	0.000	0.000	0.537	0.029	0.248	2.358	7.7	11
LTON-114-R-2000	4.91	540.4	-10.3	84.310	1.189	101.960	0.003	0.003	0.000	0.000	0.030	1.318	0.015	0.218	0.922	8.6	1.7
MARS-205-R-2000	8.07	687.3	6023.9	40.393	4.048	30.373	0.007	0.008	0.001	0.000	0.039	4.342	0.110	2.792	1.306	8.6	15.4
MARS-210-R-2000	8.12	696.3	6788.4	44.101	4.238	34.145	0.013	0.017	0.004	0.000	0.051	4.664	0.166	2.623	1.491	8.6	6.4
MARS-224-R-2000	7.92	659.2	4986.8	39.260	3.735	29.808	0.006	0.007	0.002	0.011	0.041	4.118	0.076	1.502	1.516	8.6	7.4
PRWA-103-R-2000	7.16	84.9	305.1	4.458	0.088	13.893	0.000	0.007	0.001	0.000	0.000	0.219	0.007	0.120	3.678	7.7	4.7
PRWA-104-R-2000	7.44	294.2	724.1	54.840	0.196	13.910	0.000	0.005	0.001	0.000	0.005	0.303	0.015	0.086	1.484	7.4	0.8
PRWA-106-R-2000	8.27	713.1	6055.5	53.012	6.293	24.307	0.010	0.030	0.012	0.000	0.000	6.973	0.160	2.250	1.037	8.9	11
PRWA-117-R-2000	6.30	46.4	101.7	1.516	0.570	8.058	0.000	0.007	0.001	0.000	0.000	0.673	0.022	0.194	1.794	NS	NS
PRWA-119-R-2000	7.55	457.0	1111.5	56.521	0.518	66.630	0.000	0.004	0.000	0.000	0.000	0.686	0.016	0.102	2.467	7.8	1.7
PRWA-122-R-2000	7.10	145.6	207.2	23.528	0.540	15.032	0.000	0.006	0.001	0.000	0.000	0.671	0.004	0.094	3.434	8.3	2.7

Physical Habitat Condition

Site	Riparian Buffer Width Left	Riparian Buffer Width Right	Adjacent Cover Left	Adjacent Cover Right	Instream Habitat Structure	Epifaunal Substrate	Velocity/Depth Diversity	Pool/Glide/Eddy Quality	Extent of Pools (m)	Riffle Run Quality	Extent of Riffles (m)	Embedded-ness	Shading	Trash Rating	Maximum Depth (cm)
LTON-102-R-2000	50	50	LN	FR	13	13	10	10	45	12	35	20	80	19	31
LTON-108-R-2000	50	50	FR	FR	8	3	6	4	50	9	30	55	85	18	18
LTON-113-R-2000	50	50	TG	TG	12	5	12	14	30	7	50	45	75	19	51
LTON-114-R-2000	50	50	FR	FR	16	11	12	13	35	14	45	25	88	19	50
MARS-205-R-2000	50	50	CP	RR	11	3	13	10	25	16	55	100	15	19	56
MARS-210-R-2000	28	3	RR	PA	16	8	17	13	35	18	50	65	80	4	62
MARS-224-R-2000	50	11	FR	PV	16	4	18	16	15	18	65	70	95	13	104
PRWA-103-R-2000	31	50	PV	LO	12	10	5	10	60	6	15	30	80	8	27
PRWA-104-R-2000	29	50	PV	PV	14	10	6	9	60	7	25	30	95	14	39
PRWA-106-R-2000	50	50	PA	CP	15	6	10	14	45	16	35	75	92	19	42
PRWA-117-R-2000	0	0	PA	PA	NS	NS	NS	NS	NS	NS	NS	NS	NS	19	NS
PRWA-119-R-2000	50	50	FR	FR	7	13	6	7	60	6	20	15	90	16	26
PRWA-122-R-2000	50	50	FR	FR	14	12	10	10	25	10	50	20	95	20	28

Potomac River WA Co/Marsh Run/Tonoloway/Little Tonoloway

Physical Habitat Modifications

Site	Buffer Breaks?	Surface Mine?	Landfill?	Channelization?	Erosion Severity Left	Erosion Severity Right	Bar Formation
LTON-102-R-2000	N	N	N	N	Mild	None	Moderate
LTON-108-R-2000	N	N	N	N	Mild	Mild	Moderate
LTON-113-R-2000	N	N	N	N	Severe	Moderate	Moderate
LTON-114-R-2000	Y	N	N	N	Moderate	Mild	Moderate
MARS-205-R-2000	N	N	N	N	Mild	Mild	None
MARS-210-R-2000	N	N	N	N	None	Moderate	Minor
MARS-224-R-2000	N	N	N	Y	None	None	Minor
PRWA-103-R-2000	N	N	N	N	Moderate	None	Minor
PRWA-104-R-2000	N	N	N	N	Moderate	Moderate	Minor
PRWA-106-R-2000	N	N	N	N	Mild	Mild	Minor
PRWA-117-R-2000	N	N	N	N	NS	NS	NS
PRWA-119-R-2000	N	N	N	N	Moderate	Moderate	Minor
PRWA-122-R-2000	N	N	N	N	Moderate	None	Minor

Potomac River WA CO/ Marsh Run/Tonoloway/Little Tonoloway

Fish Species Present

BLACKNOSE DACE
BLUEGILL
BLUNTNOST MINNOW
CENTRAL STONEROLLER
COMMON SHINER
CREEK CHUB
FALLFISH
FANTAIL DARTER
GOLDFISH
GREENSIDE DARTER
LARGEMOUTH BASS
LONGNOSE DACE
NORTHERN HOGSUCKER
PEARL DACE
POTOMAC SCULPIN
SMALLMOUTH BASS
SPOTFIN SHINER
WHITE SUCKER

Exotic Plants Present

MULTIFLORA ROSE
THISTLE

Benthic Taxa Present

ALLOCAPNIA
AMELETUS
AMPHINEMURA
ANTOCHA
BAETIDAE
CERATOPOGONIDAE
CHLOROPERLIDAE
COENAGRIONIDAE
CAECIDOTEA
CERATOPOGON
CHELIFERA
CHEUMATOPSYCHE
CHIMARRA
CHIRONOMUS
CLINOCERA
CLIOPERLA
CNEPHIA
CONCHAPELOPIA
CORYNONEURA
CRANGONYX
CRICOTOPUS
CRICOTOPUS/ORTHOCLADIUS
CRYPTOCHIRONOMUS
DIAMESA
DIPHETOR
DIPLECTRONA
DIXA
DUGESIA
ENCHYTRAEIDAE
ECTOPRIA
EPEORUS
EPHEMERELLA
EUKIEFFERIELLA
GOMPHIDAE
GORDIIDAE
GAMMARUS
HETEROTRISSOCLADIUS
HYDROPORUS
HYDROPSYCHE
IRONOQUIA
ISOPERLA
ISOTOMURUS
LEUCTRIDAE
LIMNAPHILIDAE
LUMBRICULIDAE
LEUCTRA
LIRCEUS
LYPE

MEROPELOPIA
MICROPSECTRA
MICROTENDIPES
NAIDIDAE
NANOCLADIUS
NEOPHYLAX
NIGRONIA
ORTHOCLADIINAE
OPTIOSERVUS
ORCONECTES
ORMOSIA
ORTHOCLADIUS
PERLODIDAE
PARACHIRONOMUS
PARAKIEFFERIELLA
PARALEPTOPHLEBIA
PARAMETRIOCNEMUS
PHYSELLA
POLYCENTROPUS
POLYPEDILUM
PROCLADIUS
PRODIAMESA
PROMORESIA
PROSIMULIUM
PROSTOIA
PSEUDOLIMNOPHILA
PSEUDORTHOCLADIUS
PYCNOPSYCHE
RHEOCRICOTOPUS
RHEOTANYTARSUS
RHYACOPHILA
SPHAERIIDAE
SIALIS
SIMULIUM
STAGNICOLA
STEGOPTERNA
STEMPELLINELLA
STENELMIS
STENONEMA
SYMPOSIOCCLADIUS
SYNURELLA
TABANIDAE
TUBIFICIDAE
TALLAPERLA
TANYTARSUS
THIENEMANNIELLA
TIPULA
TVETENIA
WORMALDIA

Herpetofauna Present

BULLFROG

EASTERN BOX TURTLE

GREEN FROG

NORTHERN DUSKY SALAMANDER

NORTHERN SPRING SALAMANDER

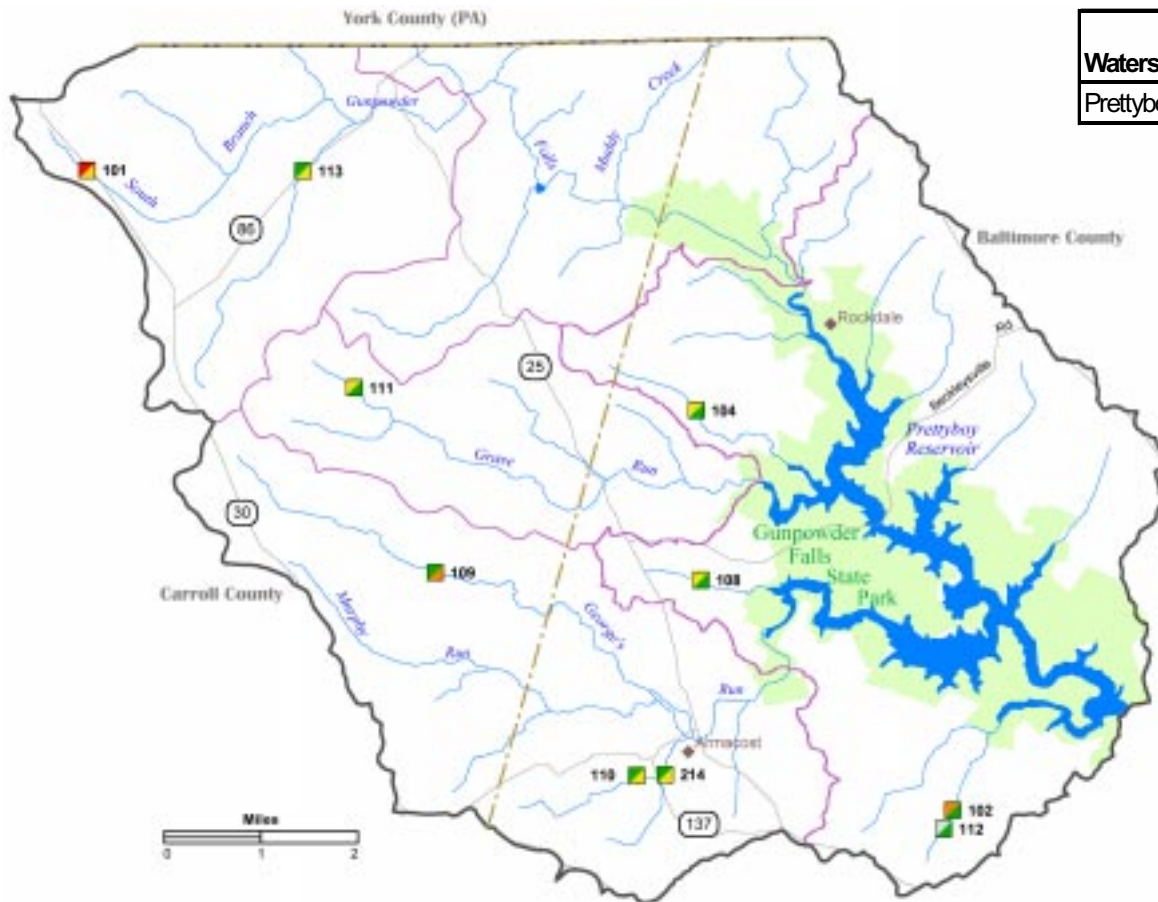
NORTHERN TWO-LINED SALAMANDER

WOOD TURTLE

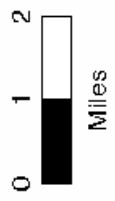
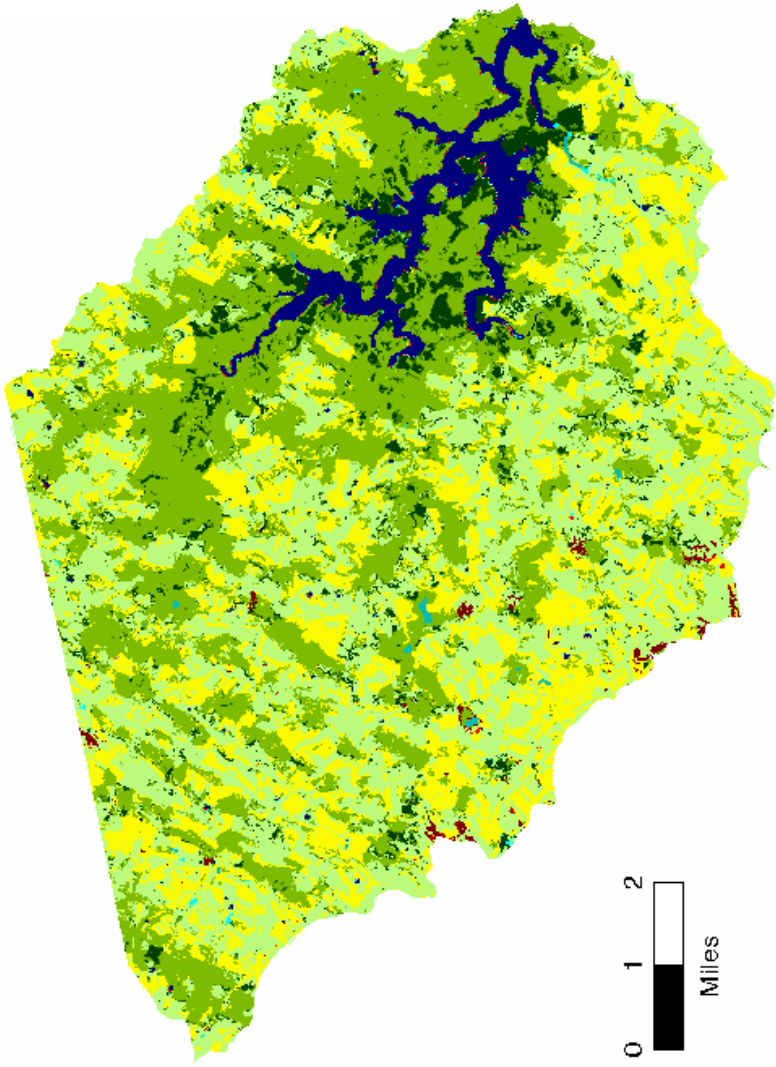
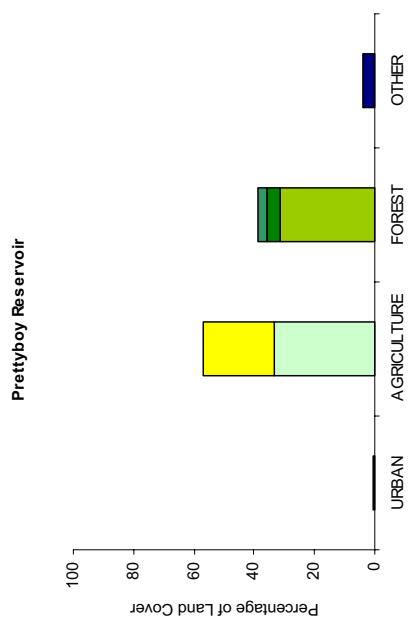


**Prettyboy Reservoir watershed
MBSS 2000**

Prettyboy Reservoir



Watershed	Total Land Area (acres)	Total Stream Miles
Prettyboy Reservoir	46455	78.44



Prettyboy Reservoir

Site Information

Site	Stream Name	12-digit Subwatershed Code	8-digit Watershed	Basin	County	Date Sampled Spring	Date Sampled Summer	Order	Catchment Area (acres)
PRET-101-R-2000	SOUTH BR GUNPOWDER FALLS	021308060317	Prettyboy Reservoir	GUNPOWDER RIVER	Carroll	03/02/00	06/12/00	1	312
PRET-102-R-2000	PRETTYBOY BR UT1	021308060313	Prettyboy Reservoir	GUNPOWDER RIVER	Baltimore	03/03/00	06/13/00	1	308
PRET-104-R-2000	POPLAR RUN	021308060313	Prettyboy Reservoir	GUNPOWDER RIVER	Baltimore	03/03/00	06/14/00	1	511
PRET-108-R-2000	COMPASS RUN	021308060313	Prettyboy Reservoir	GUNPOWDER RIVER	Baltimore	03/02/00	06/08/00	1	420
PRET-109-R-2000	GEORGE'S RUN	021308060314	Prettyboy Reservoir	GUNPOWDER RIVER	Carroll	03/02/00	06/14/00	1	1681
PRET-110-R-2000	PEGGY'S RUN UT1	021308060314	Prettyboy Reservoir	GUNPOWDER RIVER	Baltimore	03/03/00	06/08/00	1	703
PRET-111-R-2000	GRAVE RUN UT1	021308060315	Prettyboy Reservoir	GUNPOWDER RIVER	Carroll	03/02/00	06/13/00	1	364
PRET-112-R-2000	PRETTYBOY BR UT1	021308060313	Prettyboy Reservoir	GUNPOWDER RIVER	Baltimore	03/03/00	06/13/00	1	148
PRET-113-R-2000	SOUTH BR GUNPOWDER FALLS	021308060317	Prettyboy Reservoir	GUNPOWDER RIVER	Carroll	03/02/00	06/12/00	1	2097
PRET-214-R-2000	PEGGY'S RUN	021308060314	Prettyboy Reservoir	GUNPOWDER RIVER	Baltimore	03/03/00	06/07/00	2	1556

Indicator Information

Site	FIBI	BIBI	PHI	Brook Trout Present	Black Water Stream
PRET-101-R-2000	1.44	3.67	45.25	0	0
PRET-102-R-2000	2.11	4.56	32.23	0	0
PRET-104-R-2000	3.89	4.33	99.23	1	0
PRET-108-R-2000	3.67	4.56	97.68	1	0
PRET-109-R-2000	4.11	2.78	99.19	0	0
PRET-110-R-2000	4.56	3.67	62.85	0	0
PRET-111-R-2000	3.67	4.33	61.89	1	0
PRET-112-R-2000	NR	4.33	51.38	0	0
PRET-113-R-2000	4.11	3.44	96.26	0	0
PRET-214-R-2000	5.00	3.89	91.43	0	0

Catchment Land Use Information

Site	Percent Urban	Percent Agriculture	Percent Forest	Percent Other
PRET-101-R-2000	0.4	53.9	45.4	0.30
PRET-102-R-2000	0.0	76.3	23.4	0.31
PRET-104-R-2000	0.0	66.7	33.4	0.12
PRET-108-R-2000	0.0	68.8	31.2	0.00
PRET-109-R-2000	3.5	84.4	11.8	0.32
PRET-110-R-2000	0.3	85.8	13.9	0.18
PRET-111-R-2000	0.0	73.9	26.1	0.00
PRET-112-R-2000	0.0	77.9	22.1	0.00
PRET-113-R-2000	0.3	75.9	23.8	0.33
PRET-214-R-2000	0.1	87.6	12.2	0.08

Interpretation of Watershed Condition

- IBI scores generally good; Sites 101 and 102 relatively small streams
- Agricultural land use extensive
- Nitrogen concentrations are high at all sites
- About half of sites have moderate to severe bank erosion
- Brook trout present at three sites

Prettyboy Reservoir

Water Chemistry Information

Site	Closed pH	Specific Cond.	ANC (ueq/L)	Cl (mg/L)	Nitrate-N (mg/L)	SO4 (mg/L)	P-P (mg/L)	TD-P (mg/L)	Ortho-P (mg/L)	Nitrite (mg/L)	Ammonia (mg/L)	TD-N (mg/L)	P-N (mg/L)	P-C (mg/L)	DOC (mg/L)	DO (mg/L)	Turbidity (NTUs)
PRET-101-R-2000	7.17	297.3	467.2	53.743	5.711	5.898	0.003	0.007	0.005	0.011	0.027	6.110	0.084	0.682	1.226	9.0	7.4
PRET-102-R-2000	7.04	148.0	253.9	16.756	4.667	6.220	0.002	0.014	0.008	0.009	0.017	4.847	0.033	0.286	1.123	8.4	6.1
PRET-104-R-2000	7.05	125.0	267.2	18.670	2.451	3.872	0.004	0.007	0.003	0.008	0.012	2.578	0.070	0.624	0.814	9.1	6.7
PRET-108-R-2000	7.10	185.7	225.4	35.389	2.900	6.527	0.002	0.010	0.005	0.009	0.035	3.017	0.036	0.343	1.315	9.5	3.5
PRET-109-R-2000	7.26	194.8	382.6	23.992	6.394	7.443	0.004	0.015	0.006	0.016	0.009	6.538	0.045	0.456	1.932	8.9	4.9
PRET-110-R-2000	7.20	187.0	383.6	21.895	5.227	9.330	0.002	0.011	0.007	0.012	0.015	5.649	0.022	0.164	1.011	9.3	3.8
PRET-111-R-2000	6.90	135.4	237.1	18.976	3.979	3.749	0.003	0.012	0.005	0.009	0.004	4.157	0.033	0.507	0.935	9.1	5.4
PRET-112-R-2000	6.82	173.9	200.6	26.882	5.000	5.819	0.003	0.009	0.003	0.009	0.013	5.139	0.056	0.581	0.880	8.4	3.1
PRET-113-R-2000	7.31	179.1	481.7	26.480	2.939	6.600	0.003	0.008	0.005	0.011	0.015	2.982	0.063	0.370	1.406	8.1	10.5
PRET-214-R-2000	7.22	220.3	420.4	29.546	5.680	10.224	0.002	0.012	0.007	0.013	0.012	5.778	0.031	0.150	1.336	9.9	4.4

Physical Habitat Condition

Site	Riparian Buffer Width Left	Riparian Buffer Width Right	Adjacent Cover Left	Adjacent Cover Right	Instream Habitat Structure	Epifaunal Substrate	Velocity/Depth Diversity	Pool/Glide/Eddy Quality	Extent of Pools (m)	Riffle Run Quality	Extent of Riffles (m)	Embedded-ness	Shading	Trash Rating	Maximum Depth (cm)
PRET-101-R-2000	50	12	FR	PV	11	11	8	7	7	10	67	20	65	10	29
PRET-102-R-2000	0	0	PA	PA	7	6	8	8	54	11	21	55	60	16	37
PRET-104-R-2000	50	50	FR	FR	16	15	10	10	11	15	66	25	92	18	30
PRET-108-R-2000	50	50	FR	FR	17	16	7	6	9	12	66	10	90	19	20
PRET-109-R-2000	21	50	CP	FR	16	16	16	17	22	17	53	20	85	18	66
PRET-110-R-2000	50	50	FR	LN	15	16	10	7	20	14	55	15	75	14	46
PRET-111-R-2000	0	0	PA	PA	13	14	9	8	19	14	56	25	5	16	34
PRET-112-R-2000	50	8	FR	PA	8	8	7	7	25	10	50	60	92	13	30
PRET-113-R-2000	50	50	LN	LN	14	14	17	14	50	16	25	30	60	16	77
PRET-214-R-2000	50	50	FR	OF	14	15	15	17	35	14	40	35	70	17	122

Physical Habitat Modifications

Site	Buffer Breaks?	Surface Mine?	Landfill?	Channelization?	Erosion Severity Left	Erosion Severity Right	Bar Formation
PRET-101-R-2000	Y	N	N	Y	Mild	Mild	Moderate
PRET-102-R-2000	Y	N	N	N	Moderate	Severe	Minor
PRET-104-R-2000	N	N	N	N	Moderate	Mild	Minor
PRET-108-R-2000	N	N	N	N	Moderate	Mild	Minor
PRET-109-R-2000	N	N	N	N	Moderate	Moderate	Minor
PRET-110-R-2000	Y	N	N	N	Mild	Moderate	Moderate
PRET-111-R-2000	Y	N	N	N	Mild	Mild	None
PRET-112-R-2000	N	N	N	N	Moderate	Severe	Minor
PRET-113-R-2000	Y	N	N	Y	Moderate	Mild	None
PRET-214-R-2000	N	N	N	N	Severe	Moderate	Moderate

Prettyboy Reservoir

Fish Species Present

BLACKNOSE DACE
BLUEGILL
BLUNTNOST MINNOW
BROOK TROUT
CENTRAL STONEROLLER
COMMON SHINER
CREEK CHUB
FANTAIL DARTER
GREEN SUNFISH
LARGEMOUTH BASS
LONGBOST DACE
MOTTLED SCULPIN
NORTHERN HOGSUCKER
POTOMAC SCULPIN
ROSYIDE DACE
WHITE SUCKER
YELLOW BULLHEAD

Exotic Plants Present

JAPANESE HONEYSUCKLE
MULTIFLORA ROSE
THISTLE

Benthic Taxa Present

ACERPENNA
ALLOCAPNIA
AMELETUS
AMPHINEMURA
ANCHYTARSUS
ANTOCHA
BAETIDAE
BRILLIA
CHLOROPERLIDAE
COLLEMBOLA
CENTROPTILUM
CERATOPOGON
CHEUMATOPSYCHE
CHIMARRA
CLINOCERA
CONCHAPELOPIA
CORYNONEURA
CRICOTOPUS
CRICOTOPUS/ORTHOCLADIUS
CULICOIDES
DIAMESA
DICRANOTA
DIPLECTRONA
DUGESIA
ENCHYTRAEIDAE
ECCOPTURA
EPEORUS
EPHEMERELLA
EUKIEFFERIELLA
EURYLOPHELLA
GLOSSOSOMA
HEPTAGENIIDAE
HELENIELLA
HEMERODROMIA
HETEROTRISSOCLADIUS
HEXATOMA
HYDROPSYCHE
ISONYCHIA
LEPTOPHLEBIIDAE
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LUMBRICULIDAE
LARSIA
LEPIDOSTOMA
LYPE
MEROPELOPIA
MICROPSECTRA

MICROTENDIPES

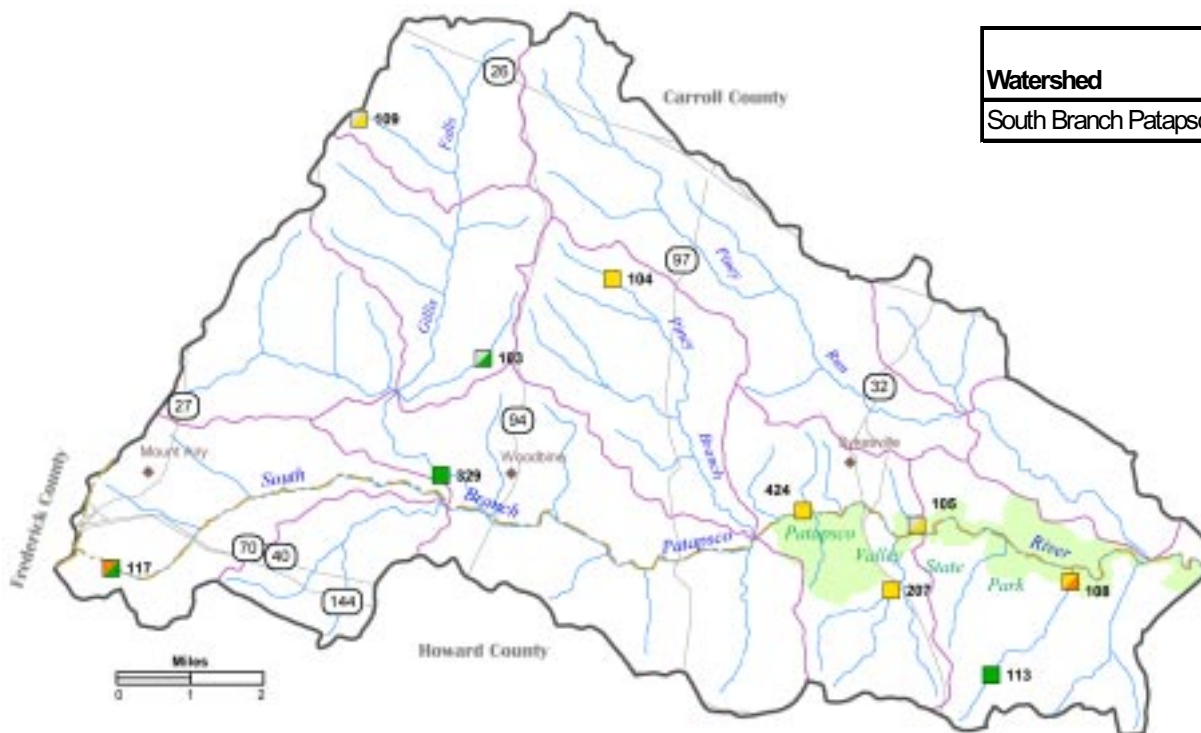
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OULIMNIUS
PERLODIDAE
POLYCENTROPODIDAE
PARALEPTOPHLEBIA
PARAMETRIOCNEMUS
PARAPHAENOCLADIUS
POLYPEDILUM
PROBEZZIA
PRODIAMESA
PROSIMULIUM
PROSTOIA
PSEUDOLIMNOPHILA
PSILOTRETA
PTILOSTOMIS
PYCNOPSYCHE
RHEOTANYTARSUS
RHYACOPHILA
SPHAERIIDAE
SIMULIUM
STEGOPTERNA
STEMPELLINELLA
STENELMIS
STENONEMA
STILOCLADIUS
STROPHOPTERYX
SYMPOTTHASTIA
TABANIDAE
TANYTARSINI
TIPULIDAE
TUBIFICIDAE
TAENIOPTERYX
TALLAPERLA
TANYTARSUS
THIENEMANNIELLA
TIPULA
TRISSOPELOPIA
TVETENIA

Herpetofauna Present

BULLFROG
COMMON SNAPPING TURTLE
GREEN FROG
NORTHERN DUSKY SALAMANDER
NORTHERN TWO-LINED SALAMANDER
NORTHERN WATER SNAKE
PICKEREL FROG

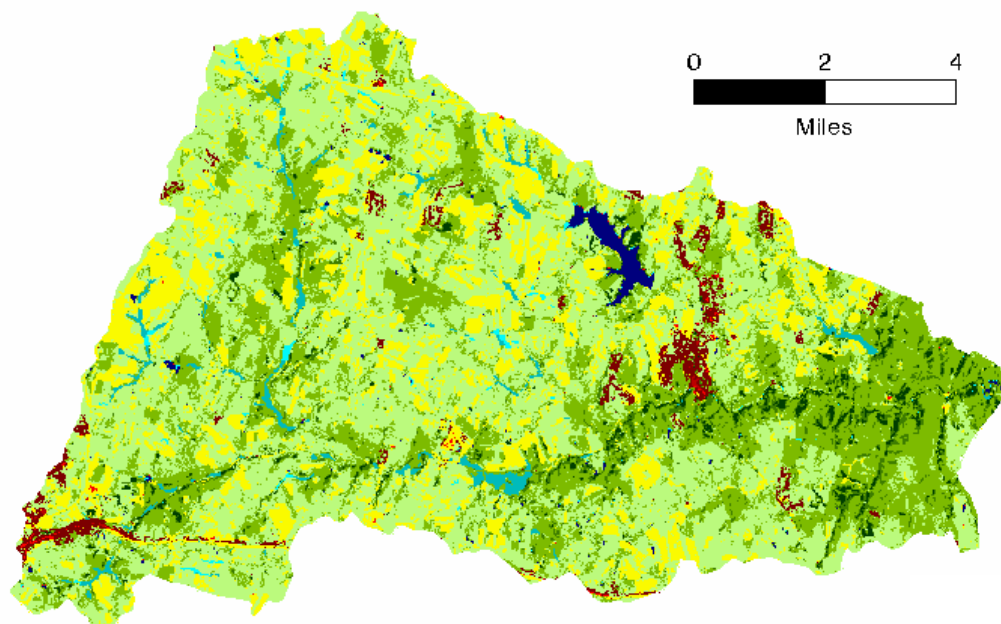


**South Branch Patapsco
watershed
MBSS 2000**

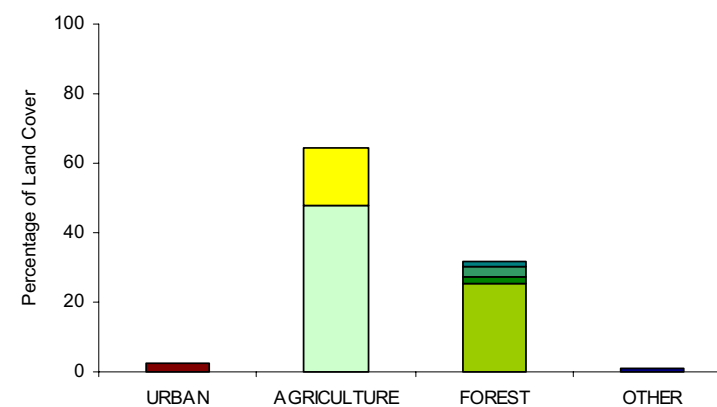


Watershed	Total Land Area (acres)	Total Stream Miles
South Branch Patapsco	54938	118.2

South Branch Patapsco



South Branch Patapsco



South Branch Patapsco

Site Information

Site	Stream Name	12-digit Subwatershed Code	8-digit Watershed	Basin	County	Date Sampled Spring	Date Sampled Summer	Order	Catchment Area (acres)
SBPA-103-R-2000	GILLIS FALLS UT1	021309081030	S BR Patapsco	PATAPSCO RIVER	Carroll	03/06/00	06/15/00	1	264
SBPA-104-R-2000	PINEY BR UT1	021309081026	S BR Patapsco	PATAPSCO RIVER	Carroll	03/06/00	06/21/00	1	337
SBPA-105-R-2000	SOUTH BR PATAPSCO R UT5	021309081022	S BR Patapsco	PATAPSCO RIVER	Carroll	03/08/00	06/20/00	1	230
SBPA-108-R-2000	SOUTH BR PATAPSCO R UT3	021309081020	S BR Patapsco	PATAPSCO RIVER	Howard	03/07/00	06/19/00	1	1471
SBPA-109-R-2000	GILLIS FALLS UT2	021309081031	S BR Patapsco	PATAPSCO RIVER	Carroll	03/06/00	06/22/00	1	50
SBPA-113-R-2000	SOUTH BR PATAPSCO R UT3	021309081020	S BR Patapsco	PATAPSCO RIVER	Howard	03/07/00	06/20/00	1	368
SBPA-117-R-2000	SOUTH BR PATAPSCO R UT1	021309081028	S BR Patapsco	PATAPSCO RIVER	Howard, Carroll	03/08/00	06/21/00	1	304
SBPA-207-R-2000	SOUTH BR PATAPSCO R UT4	021309081022	S BR Patapsco	PATAPSCO RIVER	Howard	03/07/00	06/19/00	2	1393
SBPA-329-R-2000	GILLIS FALLS	021309081025	S BR Patapsco	PATAPSCO RIVER	Carroll	03/06/00	08/14/00	3	12122
SBPA-424-R-2000	SOUTH BR PATAPSCO R	021309081022	S BR Patapsco	PATAPSCO RIVER	Howard, Carroll	03/07/00	08/14/00	4	33224

Indicator Information

Site	FIBI	BIBI	PHI	Brook Trout Present	Black Water Stream
SBPA-103-R-2000	NR	4.33	39.27	0	0
SBPA-104-R-2000	3.44	3.44	37.81	0	0
SBPA-105-R-2000	NR	3.00	73.84	0	0
SBPA-108-R-2000	3.67	2.33	66.13	0	0
SBPA-109-R-2000	NR	3.44	44.74	0	0
SBPA-113-R-2000	4.33	4.78	87.86	0	0
SBPA-117-R-2000	2.56	4.33	25.53	0	0
SBPA-207-R-2000	3.67	3.44	97.94	0	0
SBPA-329-R-2000	4.11	4.11	97.58	0	0
SBPA-424-R-2000	3.67	3.89	73.04	0	0

Catchment Land Use Information

Site	Percent Urban	Percent Agriculture	Percent Forest	Percent Other
SBPA-103-R-2000	0.0	94.5	5.3	0.4
SBPA-104-R-2000	10.5	77.3	12.1	0.0
SBPA-105-R-2000	4.2	66.2	29.7	0.6
SBPA-108-R-2000	0.5	31.5	68.0	0.1
SBPA-109-R-2000	0.0	94.9	5.1	0.0
SBPA-113-R-2000	0.1	66.2	33.7	0.0
SBPA-117-R-2000	2.3	75.2	22.3	1.5
SBPA-207-R-2000	0.1	80.5	19.5	0.2
SBPA-329-R-2000	0.8	72.9	25.8	0.5
SBPA-424-R-2000	2.0	71.3	26.3	0.7

Interpretation of Watershed Condition

- Agricultural land use fairly extensive
- Nitrogen concentrations high at nearly all sites
- Bank erosion at many sites
- Some sites located in pastures where cows have access to streams

South Branch Patapsco

Water Chemistry Information

Site	Closed pH	Specific Cond.	ANC (ueq/L)	Cl (mg/L)	Nitrate-N (mg/L)	SO4 (mg/L)	P-P (mg/L)	TD-P (mg/L)	Ortho-P (mg/L)	Nitrite (mg/L)	Ammonia (mg/L)	TD-N (mg/L)	P-N (mg/L)	P-C (mg/L)	DOC (mg/L)	DO (mg/L)	Turbidity (NTUs)
SBPA-103-R-2000	7.00	180.2	289.9	19.585	7.699	6.187	0.005	0.012	0.007	0.018	0.028	8.017	0.031	0.175	0.951	8.4	3.7
SBPA-104-R-2000	6.96	191.2	425.6	26.923	6.095	3.819	0.002	0.008	0.003	0.013	0.015	6.214	0.025	0.198	1.001	8.6	4
SBPA-105-R-2000	7.23	228.7	549.2	28.939	0.770	26.589	0.001	0.011	0.005	0.006	0.012	0.862	0.007	0.154	1.235	7.7	4.1
SBPA-108-R-2000	7.41	159.0	497.9	20.372	1.801	9.821	0.001	0.009	0.004	0.009	0.010	1.891	0.006	0.068	1.203	8.2	3.3
SBPA-109-R-2000	6.99	204.9	355.3	36.691	3.615	5.469	0.003	0.007	0.003	0.010	0.018	3.773	0.007	0.196	0.857	7.1	5.9
SBPA-113-R-2000	7.19	184.3	491.9	19.914	3.928	13.019	0.003	0.025	0.019	0.023	0.017	4.299	0.031	0.216	1.450	7.3	3.8
SBPA-117-R-2000	6.81	110.6	145.0	16.221	2.606	4.592	0.001	0.005	0.001	0.014	0.010	2.894	0.014	0.238	1.784	6.6	3.3
SBPA-207-R-2000	7.16	157.7	248.7	19.681	5.864	5.299	0.004	0.034	0.028	0.015	0.020	6.211	0.016	0.170	1.223	8.5	4.6
SBPA-329-R-2000	7.56	124.7	333.2	14.731	3.279	4.778	0.002	0.009	0.003	0.012	0.006	3.501	0.029	0.124	1.317	8.3	5.4
SBPA-424-R-2000	7.77	179.6	491.9	24.895	3.326	6.872	0.002	0.010	0.003	0.016	0.008	3.640	0.159	0.228	1.574	9.3	4.3

Physical Habitat Condition

Site	Riparian Buffer Width Left	Riparian Buffer Width Right	Adjacent Cover Left	Adjacent Cover Right	Instream Habitat Structure	Epifaunal Substrate	Velocity/Depth Diversity	Pool/Glide/Eddy Quality	Extent of Pools (m)	Riffle Run Quality	Extent of Riffles (m)	Embedded-ness	Shading	Trash Rating	Maximum Depth (cm)
SBPA-103-R-2000	50	50	LN	LN	11	12	7	7	28	11	47	30	65	16	27
SBPA-104-R-2000	50	50	LN	LN	11	12	9	7	35	12	40	35	35	16	28
SBPA-105-R-2000	50	50	FR	FR	14	13	8	7	20	11	55	20	95	19	34
SBPA-108-R-2000	10	50	PV	FR	16	16	10	9	12	16	65	20	85	19	44
SBPA-109-R-2000	50	50	LN	LN	11	11	6	7	27	7	48	25	95	17	12
SBPA-113-R-2000	0	0	PA	PA	16	14	13	14	46	12	29	40	80	15	93
SBPA-117-R-2000	50	50	FR	FR	12	11	5	8	34	8	41	15	85	17	22
SBPA-207-R-2000	50	50	FR	LN	14	16	16	15	22	15	43	20	75	16	82
SBPA-329-R-2000	50	50	FR	FR	18	16	17	17	61	16	44	10	75	18	100
SBPA-424-R-2000	50	50	RR	FR	14	10	7	17	75	11	1	30	70	15	122

Physical Habitat Modifications

Site	Buffer Breaks?	Surface Mine?	Landfill?	Channelization?	Erosion Severity Left	Erosion Severity Right	Bar Formation
SBPA-103-R-2000	N	N	N	N	Moderate	Moderate	Minor
SBPA-104-R-2000	N	N	N	N	Severe	Moderate	Minor
SBPA-105-R-2000	N	N	N	N	Mild	Mild	Moderate
SBPA-108-R-2000	N	N	N	N	Mild	Mild	Minor
SBPA-109-R-2000	N	N	N	N	Severe	Moderate	Minor
SBPA-113-R-2000	Y	N	N	N	Severe	Moderate	Moderate
SBPA-117-R-2000	N	N	N	N	Moderate	Moderate	Minor
SBPA-207-R-2000	N	N	N	N	Mild	Mild	Minor
SBPA-329-R-2000	N	N	N	N	Moderate	Severe	Moderate

SBPA-424-R-2000	N	N	N	Y	Mild	Mild	None
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South Branch Patapsco

Fish Species Present

AMERICAN EEL
BLACKNOSE DACE
BLUEGILL
BLUNTNOST MINNOW
BROWN TROUT
CENTRAL STONEROLLER
COMMON SHINER
CREEK CHUB
CUTLIPS MINNOW
FATHEAD MINNOW
GOLDEN SHINER
GREEN SUNFISH
LARGEMOUTH BASS
LEPOMIS HYBRID
LONGBEAD DACE
MOTTLED SCULPIN
NORTHERN HOGSUCKER
REDBREAST SUNFISH
RIVER CHUB
ROCK BASS
ROSYFACE SHINER
ROSYIDE DACE
SMALLMOUTH BASS
TESSELLATED DARTER
WHITE SUCKER

Exotic Plants Present

JAPANESE HONEYSUCKLE
MILE-A-MINUTE
MULTIFLORA ROSE

Benthic Taxa Present

ACERPENNA
ACRONEURIA
ALLOCAPNIA
AMELETUS
AMPHINEMURA
ANCHYTARSUS
APSECTROTANYPUS
BAETIDAE
BRILLIA
CAPNIIDAE
CENTROPTILUM
CERATOPOGON
CHEUMATOPSYCHE
CHIMARRA
CHRYSOPT
CLINOCERA
CLIOPERLA
CONCHAELOPIA
CORYNONEURA
CRANGONYX
CRICOTOPUS
CRICOTOPUS/ORTHOCLADIUS
CRYPTOCHIRONOMUS
DIAMESA
DIPLECTRONA
EPHEMERA
EPHEMERELLA
EUKIEFFERIELLA
EURYLOPHELLA
GOMPHIDAE
GORDIIDAE
HETEROTRISOCLADIUS
HEXATOMA
HYDROBAENUS
HYDROPSYCHE
ISONYCHIA
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LEPTOPHLEBIA
LEUCTRA
LYPE
MACRONYCHUS
MENETUS
MICROPSECTRA
MICROTENDIPES

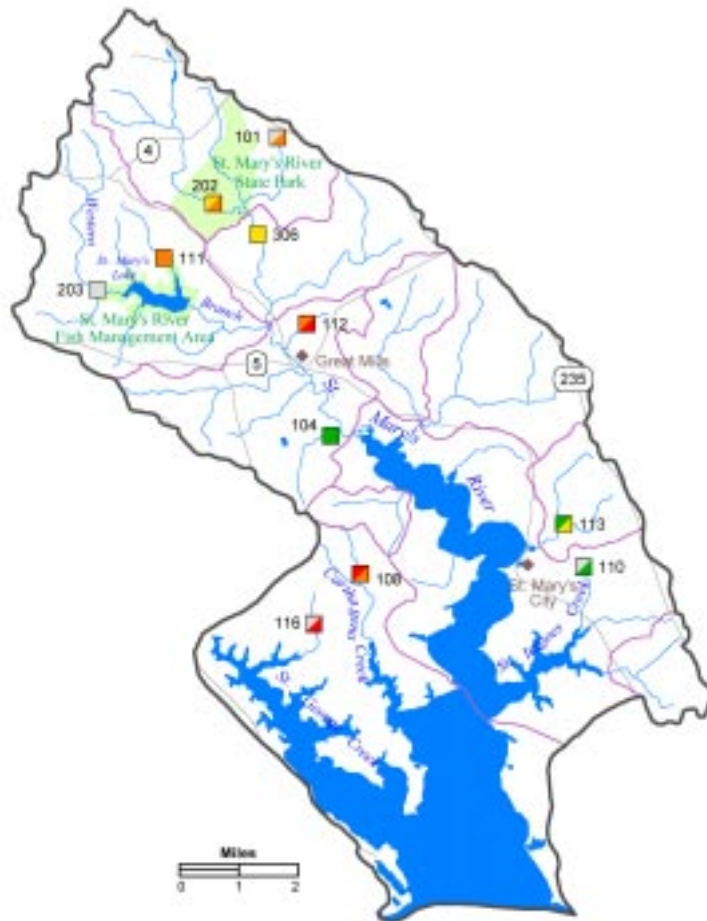
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PARAPHAENOCLADIUS
PARATANYTARSUS
PISIDIUM
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PROBEZZIA
PROSIMULIUM
PROSTOIA
PSEUDOLIMNOPHILA
PSILOTRETA
PYCNOPSYCHE
RHEOTANYTARSUS
RHYACOPHILA
SIMULIIDAE
SPHAERIIDAE
SIALIS
STEGOPTERNA
STEMPELLINELLA
STENACRON
STENONEMA
STILOCLADIUS
STROPHOPTERYX
SYMPOTTHASTIA
TABANIDAE
TIPULIDAE
TUBIFICIDAE
TANYTARSUS
THIENEMANNIELLA
TIPULA
TRIBELOS
TRISSOPELOPIA
TVETENIA
ZAVRELIMYIA

Herpetofauna Present

AMERICAN TOAD
BULLFROG
GREEN FROG
LONGBAIL SALAMANDER
NORTHERN DUSKY SALAMANDER
NORTHERN TWO-LINED SALAMANDER
NORTHERN WATER SNAKE
PICKEREL FROG
RED SALAMANDER

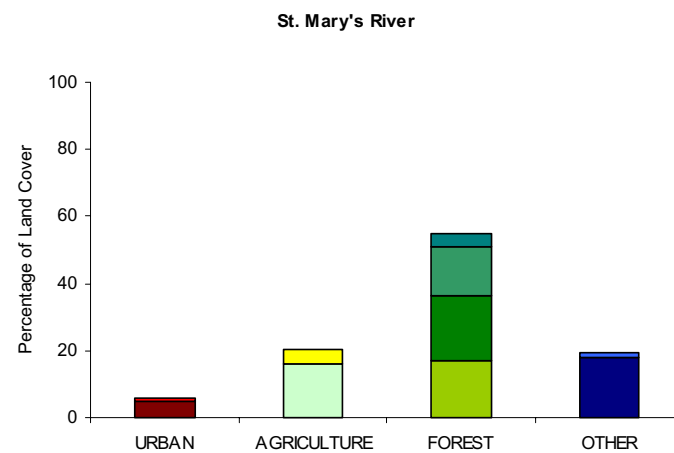
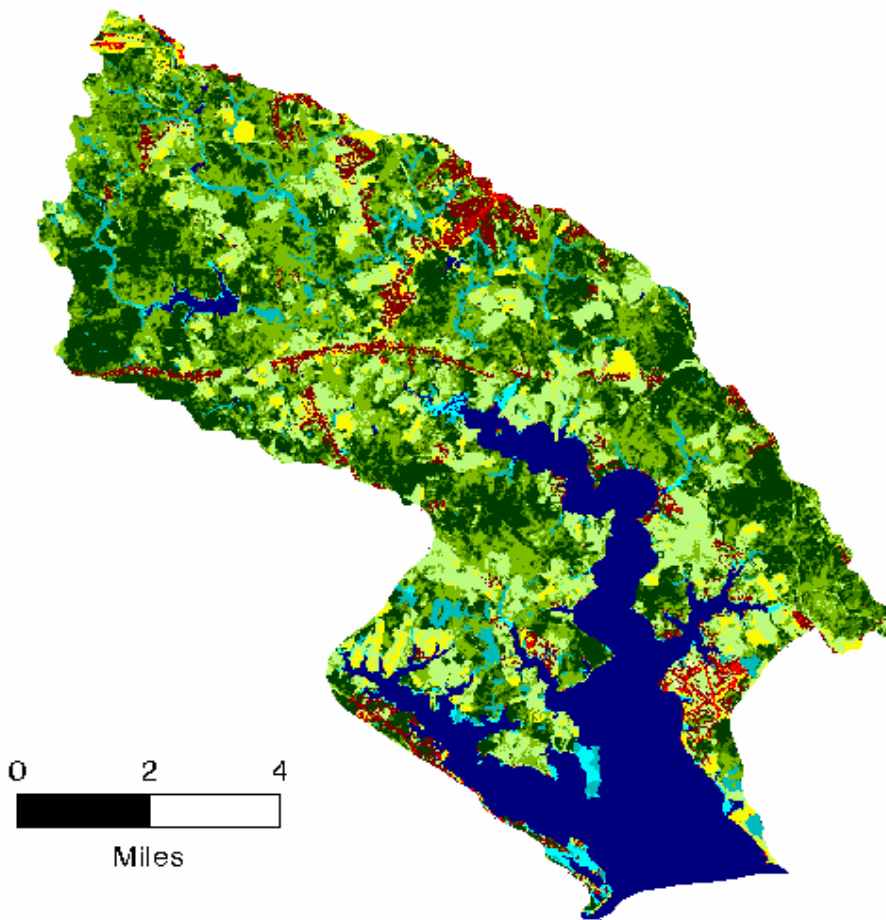


**St. Mary's River watershed
MBSS 2000**



Watershed	Total Land Area (acres)	Total Stream Miles
St. Mary's River	54641	69.7

St. Mary's River



St. Mary's River

Site Information

Site	Stream Name	12-digit Subwatershed Code	8-digit Watershed	Basin	County	Date Sampled Spring	Date Sampled Summer	Order	Catchment Area (acres)
STMA-101-R-2000	ST MARYS RIVER UT1	021401030719	St. Mary's River	LOWER POTOMAC RIVER	St. Marys	03/02/00	06/05/00	1	131
STMA-104-R-2000	WAREHOUSE RUN	021401030714	St. Mary's River	LOWER POTOMAC RIVER	St. Marys	03/01/00	06/12/00	1	905
STMA-108-R-2000	ST MARY'S RIVER UT4	021401030709	St. Mary's River	LOWER POTOMAC RIVER	St. Marys	03/02/00	06/13/00	1	370
STMA-110-R-2000	BROOM CR	021401030710	St. Mary's River	LOWER POTOMAC RIVER	St. Marys	03/02/00	06/05/00	1	75
STMA-111-R-2000	MAPLE RUN	021401030718	St. Mary's River	LOWER POTOMAC RIVER	St. Marys	03/01/00	08/23/00	1	568
STMA-112-R-2000	ST MARY'S RIVER UT2	021401030714	St. Mary's River	LOWER POTOMAC RIVER	St. Marys	03/02/00	06/12/00	1	412
STMA-113-R-2000	ST MARY'S RIVER UT3	021401030712	St. Mary's River	LOWER POTOMAC RIVER	St. Marys	03/02/00	06/05/00	1	665
STMA-116-R-2000	ST GEORGE CR UT1	021401030709	St. Mary's River	LOWER POTOMAC RIVER	St. Marys	03/03/00	06/12/00	1	213
STMA-202-R-2000	ST MARY'S RIVER	021401030719	St. Mary's River	LOWER POTOMAC RIVER	St. Marys	03/03/00	08/25/00	2	3029
STMA-203-R-2000	WESTERN BR ST MARY'S RIVER	021401030718	St. Mary's River	LOWER POTOMAC RIVER	St. Marys	03/01/00	NS	2	2308
STMA-306-R-2000	ST MARY'S RIVER	021401030717	St. Mary's River	LOWER POTOMAC RIVER	St. Marys	03/03/00	08/23/00	3	5588

Indicator Information

Site	FIBI	BIBI	PHI	Brook Trout Present	Black Water Stream
STMA-101-R-2000	NR	2.14	1.92	0	0
STMA-104-R-2000	4.75	4.43	92.91	0	0
STMA-108-R-2000	1.00	2.71	94.29	0	0
STMA-110-R-2000	NR	4.14	77.00	0	0
STMA-111-R-2000	2.00	2.43	93.67	0	0
STMA-112-R-2000	2.00	1.29	82.48	0	0
STMA-113-R-2000	4.00	3.29	54.58	0	0
STMA-116-R-2000	NS	1.00	NS	0	1
STMA-202-R-2000	3.50	2.43	90.69	0	1
STMA-203-R-2000	NS	NS	NS	NS	NS
STMA-306-R-2000	3.25	3.86	92.15	0	0

Catchment Land Use Information

Site	Percent Urban	Percent Agriculture	Percent Forest	Percent Other
STMA-101-R-2000	41.5	16.8	41.7	0.2
STMA-104-R-2000	3.8	14.2	81.8	1.0
STMA-108-R-2000	0.0	5.6	94.4	0.0
STMA-110-R-2000	0.0	23.7	75.9	1.7
STMA-111-R-2000	0.2	11.9	87.9	0.0
STMA-112-R-2000	24.9	32.1	43.1	0.3
STMA-113-R-2000	10.6	23.5	66.0	0.0
STMA-116-R-2000	0.0	23.4	76.6	0.0
STMA-202-R-2000	5.6	20.8	73.0	1.6
STMA-203-R-2000	0.6	5.7	93.2	0.6
STMA-306-R-2000	8.0	22.2	69.4	1.2

Interpretation of Watershed Condition

- Phosphorous concentrations somewhat high; also some high nitrite, ammonia, and particulate nitrogen values
- Site 101 begins in a stormwater collection pond, lots of urban impacts, very small with low flow, intermittent stream, dry in summer throughout 15 m of segment, clay substrate, low DO, trash
- Site 104 is very close to road (shoulder of road is left bank); pasture along right bank, but animals do not have access to stream
- Several sites with low pH and ANC (108, 111, 116, 203)
- Site 111 adjacent to recent clearcut beyond buffer, site is just upstream of St. Mary's Lake
- Poor bank stability at Site 112, right bank slumping
- Stream at Site 113 recently flooded by beaver dam 30m below site
- Site 116 very small, little flow in spring, dry in summer

- Site 202 flows through wetland; beaver dams up and downstream.
- Site 306 flows through wetland

St. Mary's River

Water Chemistry Information

Site	Closed pH	Specific Cond.	ANC (ueq/L)	Cl (mg/L)	Nitrate-N (mg/L)	SO4 (mg/L)	P-P (mg/L)	TD-P (mg/L)	Ortho-P (mg/L)	Nitrite (mg/L)	Ammonia (mg/L)	TD-N (mg/L)	P-N (mg/L)	P-C (mg/L)	DOC (mg/L)	DO (mg/L)	Turbidity (NTUs)
STMA-101-R-2000	6.66	387.4	626.0	72.729	0.000	11.895	0.016	0.017	0.007	0.011	0.006	0.333	0.135	1.649	7.645	3.0	26.4
STMA-104-R-2000	6.76	94.9	211.9	10.641	0.452	10.834	0.010	0.016	0.005	0.010	0.028	0.700	0.014	0.438	4.242	7.2	10.1
STMA-108-R-2000	4.95	51.5	-7.7	6.786	0.032	8.010	0.001	0.007	0.005	0.007	0.002	0.139	0.013	0.155	2.321	9.4	30.8
STMA-110-R-2000	6.32	104.8	178.8	14.924	0.528	10.397	0.005	0.014	0.006	0.010	0.031	0.650	0.023	0.236	2.314	6.9	5
STMA-111-R-2000	5.69	57.0	28.0	8.489	0.022	7.307	0.001	0.007	0.005	0.008	0.012	0.165	0.082	0.784	3.471	7.2	5.8
STMA-112-R-2000	6.82	130.8	334.2	16.583	0.072	14.642	0.006	0.014	0.005	0.008	0.010	0.259	0.049	0.396	2.774	9.8	7.9
STMA-113-R-2000	6.15	105.4	99.8	14.850	0.326	14.553	0.003	0.009	0.005	0.009	0.103	0.570	0.040	0.577	3.457	9.5	5.6
STMA-116-R-2000	4.80	94.7	7.5	11.729	0.000	12.645	0.004	0.022	0.005	0.014	0.040	0.876	0.213	2.739	33.384	NS	NS
STMA-202-R-2000	6.23	78.5	92.5	14.136	0.217	5.040	0.003	0.009	0.005	0.010	0.044	0.541	0.057	0.818	8.928	5.2	7
STMA-203-R-2000	5.23	52.9	2.4	8.865	0.000	5.053	0.001	0.007	0.005	0.007	0.006	0.247	0.077	1.486	5.584	NS	NS
STMA-306-R-2000	6.45	108.1	159.0	19.625	0.306	6.239	0.006	0.021	0.005	0.011	0.140	0.674	0.105	0.955	5.887	6.0	10

Physical Habitat Condition

Site	Riparian Buffer Width Left	Riparian Buffer Width Right	Adjacent Cover Left	Adjacent Cover Right	Instream Habitat Structure	Epifaunal Substrate	Velocity/ Depth Diversity	Pool/Glide/ Eddy Quality	Extent of Pools (m)	Riffle Run Quality	Extent of Riffles (m)	Embedded-ness	Shading	Trash Rating	Maximum Depth (cm)
STMA-101-R-2000	50	50	PV	PV	3	2	1	3	60	0	0	98	98	2	21
STMA-104-R-2000	3	8	PV	PA	15	14	12	18	55	9	20	55	90	13	134
STMA-108-R-2000	50	50	FR	PA	18	16	13	17	60	12	20	30	85	19	70
STMA-110-R-2000	50	50	FR	FR	11	11	11	13	65	8	15	30	95	20	50
STMA-111-R-2000	50	50	FR	FR	16	8	12	16	74	6	3	45	85	20	110
STMA-112-R-2000	50	50	HO	FR	16	13	11	15	45	7	35	35	92	10	66
STMA-113-R-2000	50	50	CP	FR	8	5	11	11	70	6	15	80	70	19	62
STMA-116-R-2000	50	50	FR	FR	NS	NS	NS	NS	NS	NS	NS	NS	NS	20	NS
STMA-202-R-2000	50	50	FR	FR	18	14	9	18	75	0	0	85	55	20	102
STMA-203-R-2000	50	50	FR	FR	NS	NS	NS	NS	NS	NS	NS	NS	NS	20	NS
STMA-306-R-2000	50	50	FR	FR	16	13	15	18	70	11	10	80	90	20	74

Physical Habitat Modifications

Site	Buffer Breaks?	Surface Mine?	Landfill?	Channelization?	Erosion Severity Left	Erosion Severity Right	Bar Formation
STMA-101-R-2000	N	N	N	N	Mild	Mild	None
STMA-104-R-2000	Y	N	N	N	Mild	Moderate	Moderate
STMA-108-R-2000	N	N	N	N	Mild	Mild	Severe
STMA-110-R-2000	N	N	N	N	Moderate	Moderate	Minor
STMA-111-R-2000	N	N	N	N	Moderate	Moderate	Severe
STMA-112-R-2000	Y	N	N	N	Moderate	Severe	Moderate
STMA-113-R-2000	N	N	N	N	None	None	Severe
STMA-116-R-2000	N	N	N	N	NS	NS	NS
STMA-202-R-2000	N	N	N	N	None	None	None
STMA-203-R-2000	N	N	N	N	NS	NS	NS
STMA-306-R-2000	N	N	N	N	Mild	Mild	Severe

St. Mary's River

Fish Species Present

AMERICAN EEL
BLACKNOSE DACE
BLUEGILL
BROWN BULLHEAD
CHAIN PICKEREL
CREEK CHUBSUCKER
EASTERN MUDMINNOW
FLIER
GOLDEN SHINER
LARGEMOUTH BASS
LEAST BROOK LAMPREY
MARGINED MADTOM
PIRATE PERCH
PUMPKINSEED
REDBREAST SUNFISH
SWALLOWTAIL SHINER
TADPOLE MADTOM
TESSELLATED DARTER

Exotic Plants Present

JAPANESE HONEYSUCKLE

Benthic Taxa Present

ABLABESMYIA
ACERPENNA
ALLOCAPNIA
AMPHINEMURA
ANCHYTARSUS
BRILLIA
CERATOPOGONIDAE
CHLOROPERLIDAE
COLLEMBOLA
CRANGONYCTIDAE
CAECIDOTEA
CERATOPOGON
CHEUMATOPSYCHE
CHIMARRA
CHRYSOPTERUS
CONCHAPELOPIA
CORYNONEURA
CRANGONYX
CRICOTOPUS/ORTHOCLADIUS
DOLICHOPODIDAE
DICROTENDIPES
DIPLECTRONA
DIPLOCLADIUS
DOLOPHILODES
DUBIRAPHIA
ENALLAGMA
EUKIEFFERIELLA
EURYLOPHELLA
FERRISSIA
GOMPHIDAE
GORDIIDAE
GOMPHUS
HABROPHLEBIA
HELENIELLA
HEXATOMA
HYDROPORUS
ISOPERLA
ISOTOMURUS
LEPTOPHLEBIIDAE
LIMNephilidae
LUMBRICULIDAE
LABRUNDINIA
LEPTOPHLEBIA
LEUCTRA
MENETUS
MEROPELOPIA
MICROPSECTRA
MICROTENDIPES

NAIDIDAE
NEMOURIDAE
NANOCLADIUS
NEOPHYLAX
NIGRONIA
NYCTIOPHYLAX
ORTHOCLADIINAE
OPTIOSERVUS
ORMOSIA
OULIMNIUS
OXYETHIRA
PERLIDAE
POLYCENTROPODIDAE
PALAEMONETES
PARALEPTOPHLEBIA
PARAMETRIOCNEMUS
PARATANYTARSUS
POLYPEDILUM
PROBEZZIA
PROCLADIUS
PROSIMULIUM
PROSTOIA
PROSTOMA
PSEPHENUS
PSEUDOLIMNOPHILA
PSILOTRETA
RHEOCRICOTOPUS
RHEOTANYTARSUS
RHYACOPHILA
SALDIDAE
SPHAERIIDAE
SIALIS
SIMULIUM
SPHAERIUM
STEGOPTERNA
STENACRON
STENONEMA
STYGONECTES
SYNURELLA
TANYPODINAE
TUBIFICIDAE
TABANUS
TANYTARSUS
THIENEMANNIELLA
TRIAENODES
TRISSOPELOPIA
TVETENIA
UNNIELLA
ZAVRELIMYIA

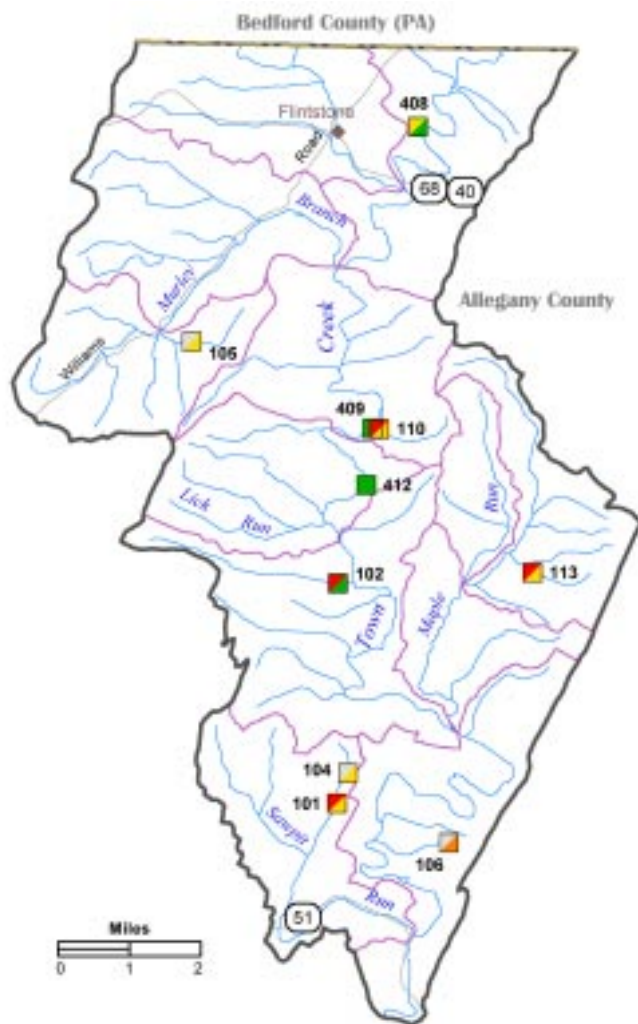
Herpetofauna Present

BULLFROG
EASTERN BOX TURTLE
GREEN FROG
NORTHERN DUSKY SALAMANDER
NORTHERN TWO-LINED SALAMANDER
PICKEREL FROG
RED SALAMANDER
SOUTHERN LEOPARD FROG

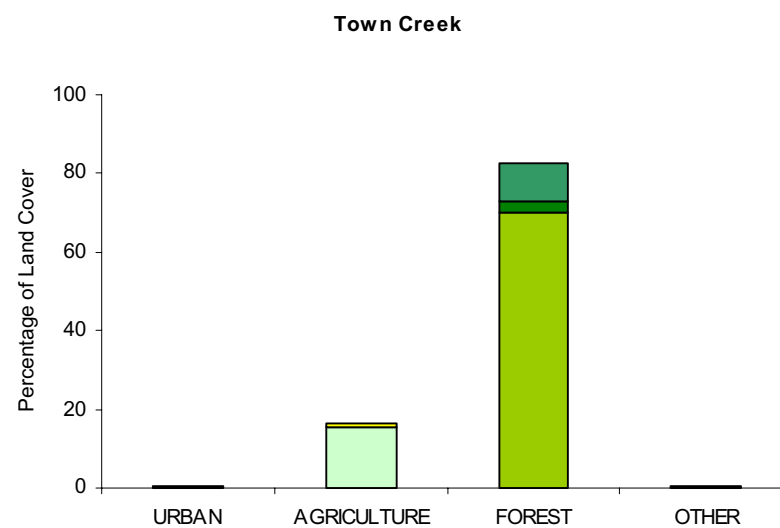
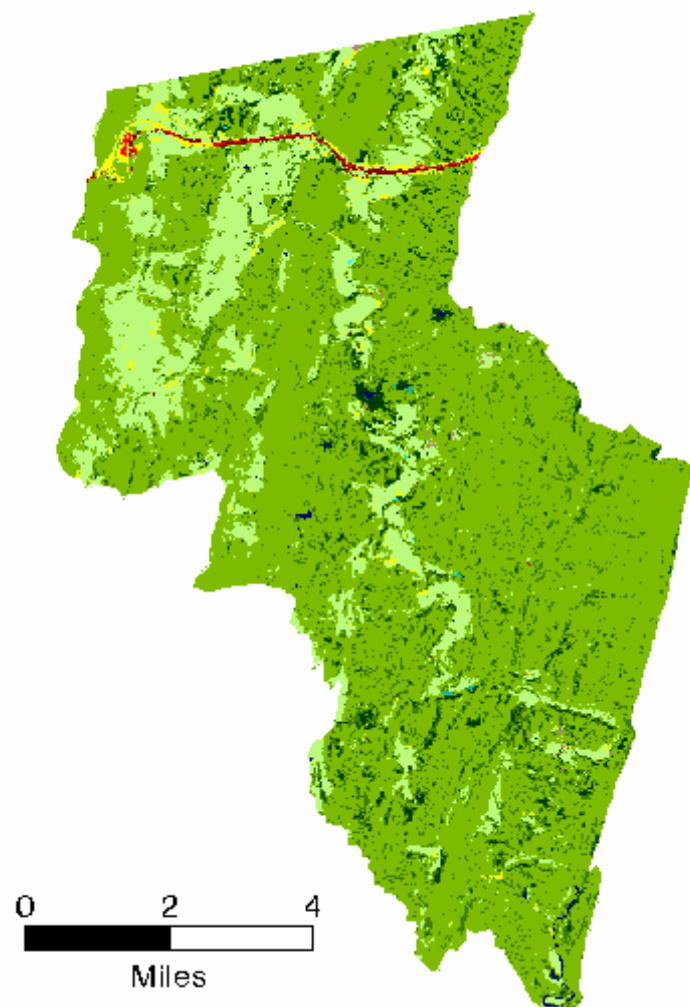


**Town Creek watershed
MBSS 2000**

Watershed	Total Land Area (acres)	Total Stream Miles
Town Creek	43411	125.4



Town Creek



Town Creek

Site Information

Site	Stream Name	12-digit Subwatershed Code	8-digit Watershed	Basin	County	Date Sampled Spring	Date Sampled Summer	Order	Catchment Area (acres)
TOWN-101-R-2000	SAWPIT RUN UT1	021405120123	Town Creek	UPPER POTOMAC RIVER	Allegany	03/23/00	08/10/00	1	357
TOWN-102-R-2000	TOWN CR UT1	021405120124	Town Creek	UPPER POTOMAC RIVER	Allegany	03/23/00	07/31/00	1	657
TOWN-104-R-2000	SAWPIT RUN UT1	021405120123	Town Creek	UPPER POTOMAC RIVER	Allegany	03/23/00	08/15/00	1	138
TOWN-105-R-2000	MURLEY BR UT1	021405120130	Town Creek	UPPER POTOMAC RIVER	Allegany	04/10/00	NS	1	570
TOWN-106-R-2000	TOWN CR UT2	021405120122	Town Creek	UPPER POTOMAC RIVER	Allegany	03/23/00	07/31/00	1	42
TOWN-110-R-2000	INDIAN LICK	021405120129	Town Creek	UPPER POTOMAC RIVER	Allegany	04/10/00	08/15/00	1	485
TOWN-113-R-2000	RAILROAD HOLLOW UT1	021405120126	Town Creek	UPPER POTOMAC RIVER	Allegany	03/23/00	08/02/00	1	396
TOWN-408-R-2000	TOWN CR	021405120131	Town Creek	UPPER POTOMAC RIVER	Allegany	04/03/00	08/31/00	4	46446
TOWN-409-R-2000	TOWN CR	021405120129	Town Creek	UPPER POTOMAC RIVER	Allegany	04/10/00	09/05/00	4	81254
TOWN-412-R-2000	TOWN CR	021405120128	Town Creek	UPPER POTOMAC RIVER	Allegany	04/10/00	09/06/00	4	82904

Indicator Information

Site	FIBI	BIBI	PHI	Brook Trout Present	Black Water Stream
TOWN-101-R-2000	1.57	3.67	7.01	0	0
TOWN-102-R-2000	1.00	4.33	6.37	0	0
TOWN-104-R-2000	NR	3.44	6.49	0	0
TOWN-105-R-2000	NS	3.67	NS	NS	NS
TOWN-106-R-2000	NS	2.56	NS	NS	NS
TOWN-110-R-2000	1.57	3.22	21.84	0	0
TOWN-113-R-2000	1.00	3.89	3.22	0	0
TOWN-408-R-2000	3.29	4.33	81.27	0	0
TOWN-409-R-2000	4.43	4.78	88.91	0	0
TOWN-412-R-2000	5.00	4.33	86.96	0	0

Catchment Land Use Information

Site	Percent Urban	Percent Agriculture	Percent Forest	Percent Other
TOWN-101-R-2000	0.0	4.0	96.0	0.2
TOWN-102-R-2000	0.0	6.0	94.0	0.1
TOWN-104-R-2000	0.0	0.0	100.0	0.0
TOWN-105-R-2000	0.0	24.9	75.2	0.0
TOWN-106-R-2000	0.0	0.0	100.0	0.0
TOWN-110-R-2000	0.1	5.0	93.4	1.6
TOWN-113-R-2000	0.0	0.0	100.0	0.0
TOWN-408-R-2000	0.0	15.5	82.6	2.0
TOWN-409-R-2000	0.2	16.7	81.9	1.3
TOWN-412-R-2000	0.2	16.7	81.9	1.3

Interpretation of Watershed Condition

- Sites were in predominantly forested catchments
- Low ANC values at several sites
- PHI scores very low first-order streams. These streams were all very small and had little to no water at time of sampling.
- Small streams in this watershed tend to be dry in the summer, some with shallow, standing pools.
- Site 409 braided channel, located at pasture but little damage to stream
- Data collection incomplete at Site 412 - only one electrofishing pass conducted and not all habitat data collected.

Town Creek

Water Chemistry Information

Site	Closed pH	Specific Cond.	ANC (ueq/L)	Cl (mg/L)	Nitrate-N (mg/L)	SO4 (mg/L)	P-P (mg/L)	TD-P (mg/L)	Ortho-P (mg/L)	Nitrite (mg/L)	Ammonia (mg/L)	TD-N (mg/L)	P-N (mg/L)	P-C (mg/L)	DOC (mg/L)	DO (mg/L)	Turbidity (NTUs)
TOWN-101-R-2000	6.65	54.3	153.1	0.959	0.008	12.640	0.000	0.005	0.000	0.000	0.000	0.080	0.010	0.067	2.262	6.7	2
TOWN-102-R-2000	6.98	79.3	287.9	3.398	0.211	13.974	0.000	0.004	0.000	0.000	0.000	0.330	0.009	0.077	2.728	5.8	0.6
TOWN-104-R-2000	6.68	50.3	127.6	0.856	0.000	12.234	0.000	0.007	0.002	0.000	0.000	0.067	0.016	0.124	2.050	5.9	4.2
TOWN-105-R-2000	8.14	490.7	3544.8	4.117	0.777	24.188	0.001	0.009	0.004	0.002	0.026	0.915	0.018	0.246	1.088	NS	NS
TOWN-106-R-2000	6.48	66.7	93.0	4.852	0.000	14.305	0.000	0.005	0.000	0.000	0.000	0.088	0.011	0.095	2.948	NS	NS
TOWN-110-R-2000	6.98	55.5	155.7	0.943	0.025	12.978	0.000	0.005	0.001	0.000	0.015	0.110	0.010	0.094	1.673	7.9	2.5
TOWN-113-R-2000	6.65	39.2	68.6	0.947	0.133	9.818	0.000	0.005	0.000	0.000	0.000	0.225	0.011	0.100	1.955	5.5	2.4
TOWN-408-R-2000	7.54	96.5	505.4	2.679	0.219	12.094	0.000	0.004	0.000	0.000	0.013	0.309	0.021	0.237	1.693	8.5	8.5
TOWN-409-R-2000	7.64	140.0	838.9	5.012	0.296	14.091	0.000	0.005	0.002	0.001	0.019	0.465	0.013	0.073	1.771	8.6	2.4
TOWN-412-R-2000	7.86	140.2	833.6	5.050	0.303	14.024	0.001	0.007	0.000	0.001	0.018	0.434	0.013	0.180	1.766	8.6	2.4

Physical Habitat Condition

Site	Riparian Buffer Width Left	Riparian Buffer Width Right	Adjacent Cover Left	Adjacent Cover Right	Instream Habitat Structure	Epifaunal Substrate	Velocity/ Depth Diversity	Pool/Glide/ Eddy Quality	Extent of Pools (m)	Riffle Run Quality	Extent of Riffles (m)	Embedded-ness	Shading	Trash Rating	Maximum Depth (cm)
TOWN-101-R-2000	0	50	CP	OF	10	11	2	10	73	4	2	25	80	19	40
TOWN-102-R-2000	50	50	FR	FR	8	10	2	4	70	4	5	10	90	18	18
TOWN-104-R-2000	50	50	FR	FR	6	8	2	7	45	0	0	15	94	20	24
TOWN-105-R-2000	5	0	PV	PA	NS	NS	NS	NS	NS	NS	NS	NS	NS	13	NS
TOWN-106-R-2000	50	50	FR	FR	NS	NS	NS	NS	NS	NS	NS	NS	NS	16	NS
TOWN-110-R-2000	50	50	FR	FR	9	15	6	7	60	7	20	10	70	10	23
TOWN-113-R-2000	50	50	FR	FR	6	11	2	8	20	0	0	15	87	20	14
TOWN-408-R-2000	50	50	FR	OF	18	17	15	15	50	16	25	15	35	16	94
TOWN-409-R-2000	0	0	PA	PA	17	16	13	16	105	14	45	15	55	10	98
TOWN-412-R-2000	50	50	TG	FR	19	18	15	16	10	17	75	10	60	19	

Physical Habitat Modifications

Site	Buffer Breaks?	Surface Mine?	Landfill?	Channelization?	Erosion Severity Left	Erosion Severity Right	Bar Formation
TOWN-101-R-2000	Y	N	N	N	Moderate	Moderate	Minor
TOWN-102-R-2000	N	N	N	N	Mild	Mild	Minor
TOWN-104-R-2000	N	N	N	N	Moderate	Moderate	Moderate
TOWN-105-R-2000	Y	N	N	Y	NS	NS	NS
TOWN-106-R-2000	N	N	N	N	NS	NS	NS
TOWN-110-R-2000	N	N	N	N	Moderate	Moderate	None
TOWN-113-R-2000	N	N	N	N	None	None	Minor
TOWN-408-R-2000	N	N	N	N	Severe	None	Moderate
TOWN-409-R-2000	Y	N	N	N	None	Moderate	Moderate

TOWN-412-R-2000	N	N	N	N	None	None	None
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Town Creek

Fish Species Present

BLACKNOSE DACE
 BLUEGILL
 BLUNTNOSE MINNOW
 BROWN TROUT
 CENTRAL STONEROLLER
 CHAIN PICKEREL
 COMELY SHINER
 COMMON SHINER
 CREEK CHUB
 CUTLIPS MINNOW
 FALLFISH
 FANTAIL DARTER
 GOLDEN REDHORSE
 GREEN SUNFISH
 GREENSIDE DARTER
 LARGEMOUTH BASS
 LONGEAR SUNFISH
 LONGNOSE DACE
 MARGINED MADTOM
 MOTTLED SCULPIN
 NORTHERN HOGSUCKER
 POTOMAC SCULPIN
 RAINBOW DARTER
 REDBREAST SUNFISH
 RIVER CHUB
 ROCK BASS
 ROSYFACE SHINER
 SILVERJAW MINNOW
 SMALLMOUTH BASS
 SPOTFIN SHINER
 SPOTTAIL SHINER
 STRIPED SHINER
 TESSELLATED DARTER
 WHITE SUCKER
 YELLOW BULLHEAD

Exotic Plants Present

MULTIFLORA ROSE
 THISTLE

Benthic Taxa Present

ACENTRELLA
 ALLOCAPNIA
 AMELETUS
 AMPHINEMURA
 CAMBARIDAE
 CAPNIIDAE
 CHLOROPERLIDAE
 COLLEMBOLA
 CAECIDOTEA
 CAENIS
 CHIMARRA
 CLINOCERA
 CONCHAPELOPIA
 CORYNONEURA
 CRICOTOPUS
 CRICOTOPUS/ORTHOCLADIUS
 DIAMESA
 DICRANOTA
 DIPHETOR
 DIPLECTRONA
 DOLOPHILODES
 DRUNELLA
 DUBIRAPHIA
 EMPIDIDAE
 EPEORUS
 EPHEMERELLA
 EUKIEFFERIELLA
 EURYLOPHELLA
 GLOSSOSOMATIDAE
 GAMMARUS
 HEPTAGENIIDAE
 HABROPHLEBIA
 HELENIELLA
 HEMERODROMIA
 HETEROTRISSOCLADIUS
 HYDROPSYCHE
 ISONYCHIA
 ISOPERLA
 ISOTOMURUS
 KRENOPELOPIA
 LEPTOPHLEBIIDAE
 LEUCTRIDAE
 LIMNEPHILIDAE
 LUMBRICULIDAE

LEPTOXIS
 LEUCTRA
 MUSCIDAE
 MEROPELOPIA
 MICROPSECTRA
 MICROTENDIPES
 NAIDIDAE
 NEMOURIDAE
 NEOPHYLAX
 NIGRONIA
 ORTHOCLADIINAE
 OPTIOSERVUS
 ORTHOTRICHIA
 PERLIDAE
 PERLODIDAE
 PARALEPTOPHLEBIA
 PARAMETRIOCNEMUS
 PARATANYTARSUS
 POLYPEDILUM
 PROSIMULIUM
 PROSTOIA
 PSEPHENUS
 PSEUDOLIMNOPHILA
 RHEOCRICOTOPUS
 RHYACOPHILA
 SIMULIIDAE
 SERRATELLA
 SIMULIUM
 STEGOPTERNA
 STEMPELLINA
 STEMPELLINELLA
 STENACRON
 STENELMIS
 STENONEMA
 STYGONECTES
 SWELTSIA
 TORTRICIDAE
 TURBELLARIA
 TANYTARSUS
 THIENEMANNIELLA
 TIPULA
 TRISSOPELOPIA
 TVETENIA
 ZAVRELIMYIA

Herpetofauna Present

BLACK RAT SNAKE
 BULLFROG
 COMMON MUSK TURTLE
 COMMON SNAPPING TURTLE
 FIVE-LINED SKINK
 GREEN FROG
 NORTHERN DUSKY SALAMANDER
 NORTHERN FENCE LIZARD
 NORTHERN WATER SNAKE
 WOOD TURTLE

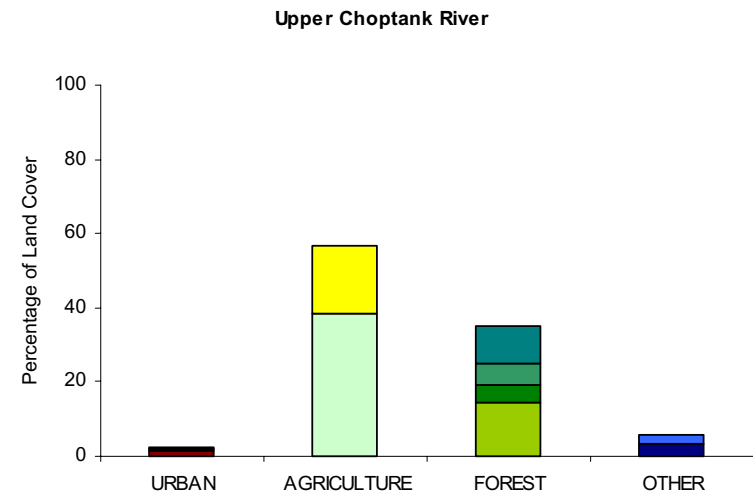
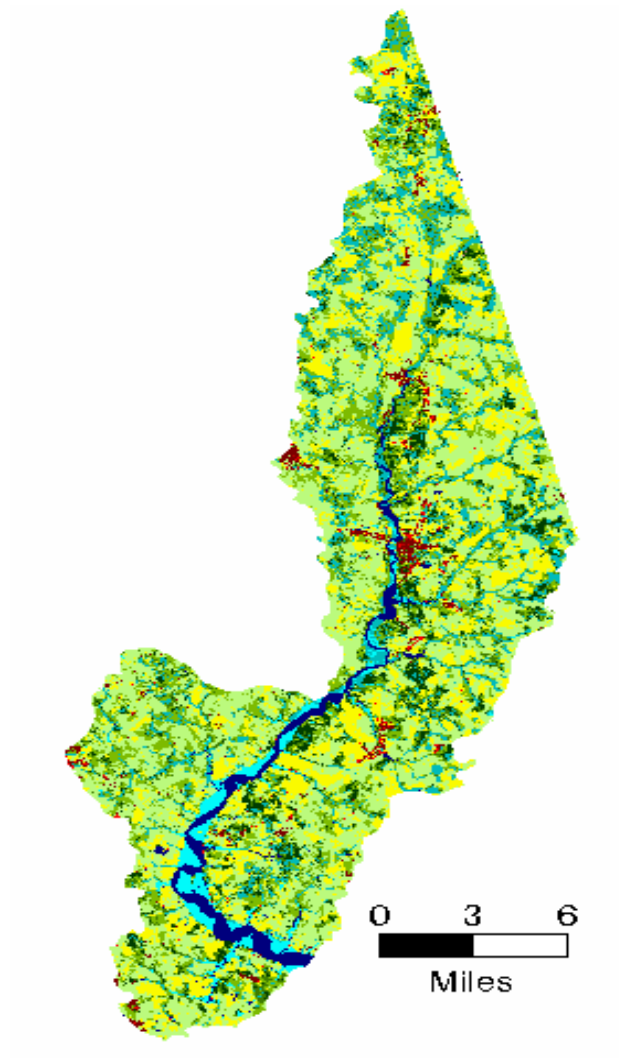


**Upper Choptank River
watershed
MBSS 2000**



Watershed	Total Land Area (acres)	Total Stream Miles
Upper Choptank River	163699	241

Upper Choptank River



Upper Choptank River

Site Information

Site	Stream Name	12-digit Subwatershed Code	8-digit Watershed	Basin	County	Date Sampled Spring	Date Sampled Summer	Order	Catchment Area (acres)
UPCK-101-R-2000	FORGE BR UT1	021304040505	Upper Choptank	CHOPTANK RIVER	Caroline	04/06/00	08/01/00	1	140
UPCK-102-R-2000	OLDTOWN BR UT1	021304040508	Upper Choptank	CHOPTANK RIVER	Caroline	04/11/00	07/27/00	1	338
UPCK-108-R-2000	MILES CR UT1	021304040472	Upper Choptank	CHOPTANK RIVER	Talbot	04/05/00	07/31/00	1	888
UPCK-109-R-2000	HARRINGTON BEAVERDAM DITCH UT1	021304040515	Upper Choptank	CHOPTANK RIVER	Caroline	04/11/00	07/25/00	1	1278
UPCK-115-R-2000	TIDY ISLAND CR UT1	021304040514	Upper Choptank	CHOPTANK RIVER	Caroline	04/11/00	07/27/00	1	618
UPCK-118-R-2000	FOWLING CR UT1	021304040485	Upper Choptank	CHOPTANK RIVER	Caroline	04/05/00	09/14/00	1	515
UPCK-119-R-2000	CHOPTANK RIVER UT1	021304040494	Upper Choptank	CHOPTANK RIVER	Caroline	04/06/00	07/24/00	1	605
UPCK-122-R-2000	ROBINS CR UT1	021304040486	Upper Choptank	CHOPTANK RIVER	Caroline	04/05/00	09/14/00	1	582
UPCK-130-R-2000	CHOPTANK RIVER UTI UT1	021304040487	Upper Choptank	CHOPTANK RIVER	Caroline	04/06/00	07/24/00	1	89
UPCK-132-R-2000	CHOPTANK RIVER UT1	021304040487	Upper Choptank	CHOPTANK RIVER	Caroline	04/06/00	07/24/00	1	733
UPCK-203-R-2000	BEAVERDAM BR	021304040483	Upper Choptank	CHOPTANK RIVER	Talbot	04/06/00	07/31/00	2	2612
UPCK-204-R-2000	BROADWAY BR	021304040509	Upper Choptank	CHOPTANK RIVER	Caroline	04/11/00	07/25/00	2	4359
UPCK-229-R-2000	WATTS CR	021304040492	Upper Choptank	CHOPTANK RIVER	Caroline	04/05/00	08/09/00	2	8534
UPCK-311-R-2000	FORGE BR	021304040505	Upper Choptank	CHOPTANK RIVER	Caroline	04/06/00	08/09/00	3	6792

Indicator Information

Site	FIBI	BIBI	PHI	Brook Trout Present	Black Water Stream
UPCK-101-R-2000	NR	1.86	43.89	0	0
UPCK-102-R-2000	2.25	1.29	34.23	0	0
UPCK-108-R-2000	3.25	3.00	42.00	0	0
UPCK-109-R-2000	3.50	2.43	15.03	0	0
UPCK-115-R-2000	3.25	1.57	63.09	0	1
UPCK-118-R-2000	NR	2.14	49.36	0	1
UPCK-119-R-2000	4.00	3.29	60.23	0	1
UPCK-122-R-2000	1.50	1.86	11.72	0	0
UPCK-130-R-2000	NR	1.86	3.65	0	0
UPCK-132-R-2000	4.00	3.00	76.21	0	1
UPCK-203-R-2000	2.50	4.43	90.31	0	0
UPCK-204-R-2000	3.50	2.43	65.62	0	0
UPCK-229-R-2000	NS	4.43	NS	NS	NS
UPCK-311-R-2000	4.00	3.29	65.62	0	0

Catchment Land Use Information

Site	Percent Urban	Percent Agriculture	Percent Forest	Percent Other
UPCK-101-R-2000	0.0	87.4	12.6	0.0
UPCK-102-R-2000	0.0	49.0	51.0	0.0
UPCK-108-R-2000	5.2	83.5	10.9	2.1
UPCK-109-R-2000	0.7	59.9	39.1	0.4
UPCK-115-R-2000	6.8	25.6	67.6	0.1
UPCK-118-R-2000	4.1	48.6	47.3	0.1
UPCK-119-R-2000	11.3	44.9	43.3	0.7
UPCK-122-R-2000	0.2	78.2	21.6	0.0
UPCK-130-R-2000	0.7	49.6	49.6	0.0
UPCK-132-R-2000	0.3	50.8	48.9	0.0
UPCK-203-R-2000	1.0	54.0	44.5	0.5
UPCK-204-R-2000	1.1	53.5	44.6	1.0
UPCK-229-R-2000	1.4	59.0	38.8	0.8
UPCK-311-R-2000	0.4	59.6	39.8	0.3

Interpretation of Watershed Condition

- ANC values low at several sites
- Nitrogen and phosphorous concentrations high at most sites
- Dissolved oxygen is low at three sites

- Channelization common
- Site 229 tidally influenced

Upper Choptank River

Water Chemistry Information

Site	Closed pH	Specific Cond.	ANC (ueq/L)	Cl (mg/L)	Nitrate-N (mg/L)	SO4 (mg/L)	P-P (mg/L)	TD-P (mg/L)	Ortho-P (mg/L)	Nitrite (mg/L)	Ammonia (mg/L)	TD-N (mg/L)	P-N (mg/L)	P-C (mg/L)	DOC (mg/L)	DO (mg/L)	Turbidity (NTUs)
UPCK-101-R-2000	6.40	134.8	178.7	14.037	3.763	13.425	0.057	0.031	0.017	0.000	0.006	4.640	0.025	0.707	7.447	6.9	13.5
UPCK-102-R-2000	5.50	92.1	55.8	9.391	0.610	16.674	0.031	0.019	0.009	0.013	0.121	1.240	0.103	2.111	5.593	5.2	9
UPCK-108-R-2000	7.10	246.3	689.9	26.887	3.838	24.298	0.052	0.120	0.104	0.024	0.180	4.639	0.070	0.817	5.356	6.5	4.3
UPCK-109-R-2000	6.91	130.0	286.0	12.672	1.493	16.910	0.021	0.025	0.010	0.014	0.028	2.060	0.071	1.204	8.699	8.3	12.3
UPCK-115-R-2000	6.51	72.6	194.7	5.845	0.515	9.530	0.049	0.044	0.038	0.021	0.077	1.325	0.093	1.437	9.478	3.3	14.7
UPCK-118-R-2000	5.90	208.5	178.4	15.937	8.570	24.252	0.018	0.055	0.035	0.003	0.099	9.234	0.042	0.426	17.953	7.7	1.9
UPCK-119-R-2000	6.32	111.1	170.0	16.701	1.600	7.776	0.004	0.016	0.002	0.000	0.027	2.314	0.048	1.125	8.948	7.8	3.7
UPCK-122-R-2000	6.49	109.7	277.3	12.625	0.688	11.627	0.008	0.064	0.042	0.000	0.204	1.696	0.051	0.666	13.392	0.8	2.2
UPCK-130-R-2000	6.61	107.6	217.3	12.875	3.518	3.806	0.029	0.023	0.000	0.016	0.014	4.748	0.924	10.358	8.161	0.8	36.5
UPCK-132-R-2000	5.91	101.9	116.2	14.628	1.177	7.650	0.006	0.058	0.025	0.000	0.206	2.788	0.073	1.455	30.694	7.7	6.5
UPCK-203-R-2000	6.83	142.2	406.2	16.236	2.328	9.765	0.014	0.042	0.019	0.000	0.071	3.414	0.166	0.790	13.554	6.9	7.5
UPCK-204-R-2000	6.61	119.5	224.5	11.733	1.436	17.389	0.019	0.008	0.002	0.011	0.027	2.017	0.079	0.841	5.567	7.6	10.7
UPCK-229-R-2000	6.77	109.1	293.5	11.618	1.652	9.113	0.021	0.033	0.013	0.000	0.080	2.456	0.043	0.496	10.123	5.6	11.9
UPCK-311-R-2000	6.52	126.5	207.9	12.157	2.851	14.234	0.017	0.022	0.008	0.000	0.007	3.538	0.055	0.700	7.015	6.3	13.4

Physical Habitat Condition

Site	Riparian Buffer Width Left	Riparian Buffer Width Right	Adjacent Cover Left	Adjacent Cover Right	Instream Habitat Structure	Epifaunal Substrate	Velocity/Depth Diversity	Pool/Glide/Eddy Quality	Extent of Pools (m)	Riffle Run Quality	Extent of Riffles (m)	Embedded-ness	Shading	Trash Rating	Maximum Depth (cm)
UPCK-101-R-2000	15	20	CP	CP	7	5	12	10	46	13	29	100	80	18	58
UPCK-102-R-2000	50	50	LN	FR	8	4	8	10	75	0	0	100	90	19	46
UPCK-108-R-2000	50	50	FR	FR	8	5	12	11	35	12	39	90	90	10	61
UPCK-109-R-2000	50	50	FR	FR	5	3	7	7	30	14	50	100	85	19	18
UPCK-115-R-2000	4	50	PK	LN	14	12	10	14	15	16	65	100	65	8	89
UPCK-118-R-2000	50	50	FR	FR	10	11	8	12	70	10	10	100	92	18	68
UPCK-119-R-2000	37	50	LN	FR	8	7	13	15	55	12	21	65	85	9	58
UPCK-122-R-2000	28	50	PA	FR	11	11	3	4	74	6	2	100	92	16	17
UPCK-130-R-2000	0	0	CP	PA	2	3	2	1	75	0	0	100	50	19	18
UPCK-132-R-2000	50	50	FR	FR	13	13	12	13	53	11	28	50	90	16	56
UPCK-203-R-2000	50	50	FR	FR	12	11	14	15	52	14	23	30	85	17	93
UPCK-204-R-2000	50	50	FR	FR	11	11	14	15	67	16	31	15	80	19	83
UPCK-229-R-2000	50	20	FR	LN	NS	NS	NS	NS	NS	NS	NS	NS	NS	18	NS
UPCK-311-R-2000	50	50	FR	FR	9	6	13	16	70	14	20	100	90	13	74

Upper Choptank River

Physical Habitat Modifications

Site	Buffer Breaks?	Surface Mine?	Landfill?	Channelization?	Erosion Severity Left	Erosion Severity Right	Bar Formation
UPCK-101-R-2000	N	N	N	Y	Mild	Moderate	Minor
UPCK-102-R-2000	N	N	N	Y	Mild	Mild	None
UPCK-108-R-2000	N	Y	N	N	Moderate	Moderate	Minor
UPCK-109-R-2000	N	N	N	Y	Mild	Mild	Minor
UPCK-115-R-2000	N	N	N	Y	None	None	None
UPCK-118-R-2000	N	N	N	Y	Mild	Mild	None
UPCK-119-R-2000	N	N	N	N	Moderate	Moderate	Moderate
UPCK-122-R-2000	N	N	N	N	None	None	None
UPCK-130-R-2000	Y	N	N	Y	None	None	None
UPCK-132-R-2000	N	N	N	N	Moderate	Moderate	Moderate
UPCK-203-R-2000	N	N	N	N	Moderate	Moderate	Severe
UPCK-204-R-2000	N	N	N	N	Moderate	Moderate	Minor
UPCK-229-R-2000	N	N	N	N	NS	NS	NS
UPCK-311-R-2000	N	N	N	Y	Mild	Mild	Moderate

Upper Choptank River

Fish Species Present

AMERICAN EEL
BLACK CRAPPIE
BLUEGILL
BLUESPOTTED SUNFISH
BROWN BULLHEAD
CHAIN PICKEREL
CREEK CHUBSUCKER
EASTERN MUDMINNOW
FALLFISH
GOLDEN SHINER
GREEN SUNFISH
LARGEMOUTH BASS
LEAST BROOK LAMPREY
MOSQUITOFISH
PIRATE PERCH
PUMPKINSEED
REDBREAST SUNFISH
REDFIN PICKEREL
SWALLOWTAIL SHINER
SWAMP DARTER
TADPOLE MADTOM
TESSELLATED DARTER
WHITE SUCKER
YELLOW BULLHEAD

Exotic Plants Present

JAPANESE HONEYSUCKLE
MILE-A-MINUTE
MULTIFLORA ROSE
REED CANARY GRASS

Benthic Taxa Present

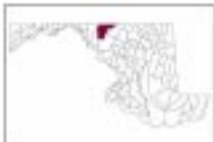
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ACENTRELLA
ACERPENNA
AGABUS
AMPHINEMURA
ANCHYTARSUS
ANCYRONYX
ARGIA
BOYERIA
CERATOPOGONIDAE
CHIRONOMINI
COENAGRIONIDAE
CORIXIDAE
CRANGONYCTIDAE
CAECIDOTEA
CAENIS
CALOPTERYX
CERATOPOGON
CHEUMATOPSYCHE
CHIRONOMUS
CNEPHIA
CONCHAPELOPIA
CORBICULA
CORYNONEURA
CRANGONYX
CRICOTOPUS/ORTHOCLADIUS
CULICOIDES
DYTISCIDAE
DICROTENDIPES
DIPLOCLADIUS
DOLOPHILODES
DUBIRAPHIA
DUGESIA
ENCHYTRAEIDAE
ENALLAGMA
EPHEMERELLA
EUKIEFFERIELLA
EURYLOPHELLA
GAMMARUS
HALIPLUS
HELICHUS
HEXATOMA
HYDATOPHYLAX
HYDROBAENUS

HYDROPORUS
IRONOQUIA
ISOPERLA
LEPTOPHLEBIIDAE
LUMBRICULIDAE
LEPIDOSTOMA
LEPTOPHLEBIA
LEUCTRA
MACRONYCHUS
MEROPELOPIA
MICROPSECTRA
MICROTENDIPES
MICROVELIA
MUSCULIUM
NAIDIDAE
NEMOURIDAE
NANOCLADIUS
NEOPHYLAX
NIGRONIA
ORTHOCLADIINAE
PERLIDAE
PHRYGANEIDAE
PARACHIRONOMUS
PARALEPTOPHLEBIA
PARAMERINA
PARAMETRIOCNEMUS
PARAPHAENOCCLADIUS
PARATANYTARSUS
PARATENDIPES
PHYSELLA
POLYCENTROPUS
POLYPEDILUM
POTTHASTIA
PROSIMULIUM
PSECTROCLADIUS
PSEUDOLIMNOPHILA
PSEUDORTHOCCLADIUS
PSEUDOSUCCINEA
PSILOTRETA
PSYCHODA
PTILOSTOMIS
PYCNOPSYCHE
RHEOCRICOTOPUS
SPHAERIIDAE
SYRPHIDAE
SIMULIUM
STAGNICOLA

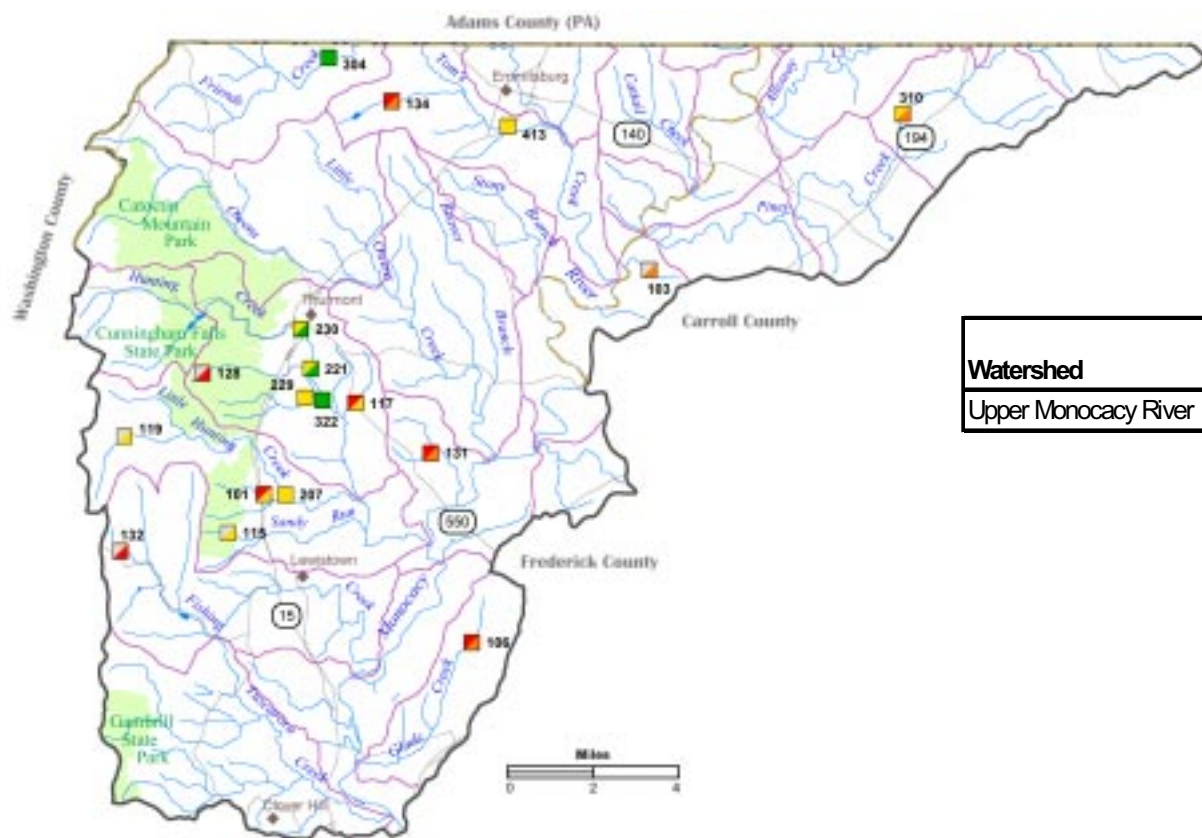
STEGOPTERNA
STENELMIS
STENONEMA
SYNURELLA
TANYPODINAE
TANYTARSINI
TUBIFICIDAE
TANYTARSUS
THIENEMANNIELLA
TIPULA
TRIAENODES
TRIBELOS
TRISSOPELOPIA
ZAVRELIMYIA

Herpetofauna Present

BULLFROG
COMMON MUSK TURTLE
COMMON SNAPPING TURTLE
EASTERN BOX TURTLE
FOWLER'S TOAD
GREEN FROG
NORTHERN RINGNECK SNAKE
PICKEREL FROG
ROUGH GREEN SNAKE
SOUTHERN LEOPARD FROG

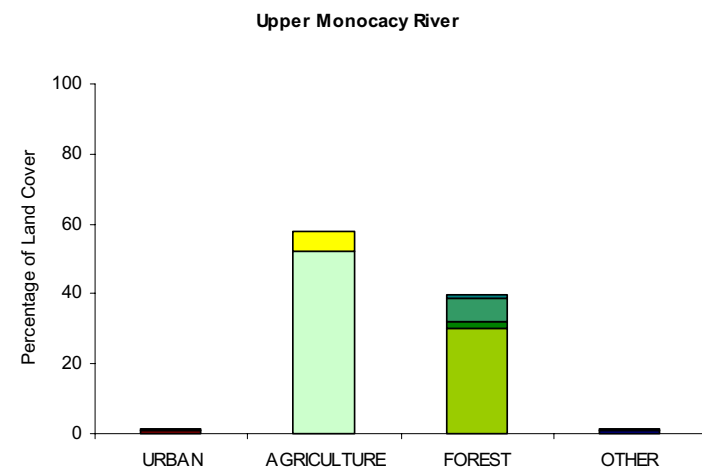
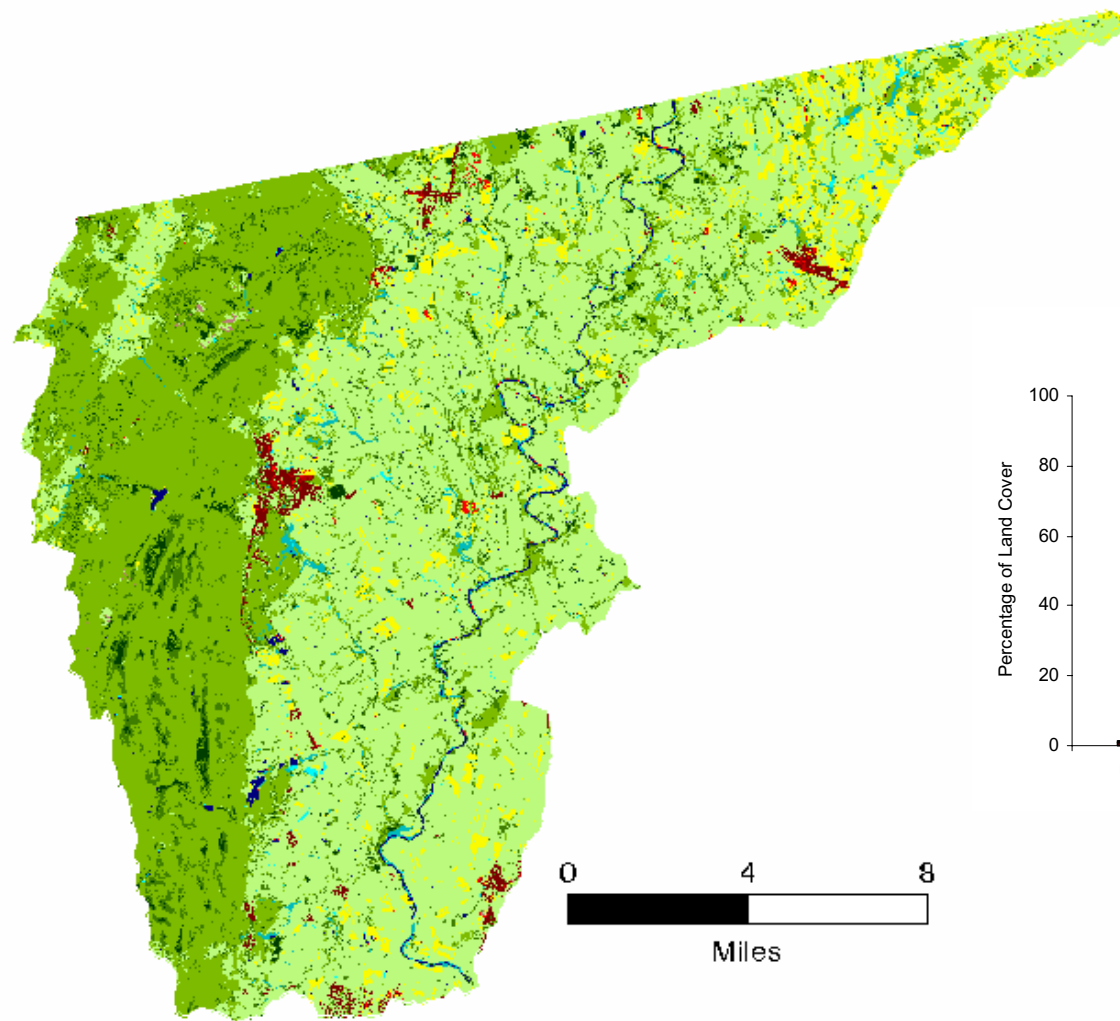


Upper Monocacy River watershed MBSS 2000



Watershed	Total Land Area (acres)	Total Stream Miles
Upper Monocacy River	156501	277

Upper Monocacy River



Upper Monocacy River

Site Information

Site	Stream Name	12-digit Subwatershed Code	8-digit Watershed	Basin	County	Date Sampled Spring	Date Sampled Summer	Order	Catchment Area (acres)
UMON-101-R-2000	LITTLE HUNTING CR UT1 UT1	021403030244	Upper Monocacy River	MIDDLE POTOMAC RIVER	Frederick	03/20/00	07/06/00	1	420
UMON-103-R-2000	MONOCACY R UT1	021403030247	Upper Monocacy River	MIDDLE POTOMAC RIVER	Carroll	03/28/00	06/27/00	1	212
UMON-106-R-2000	GLADE CR	021403030242	Upper Monocacy River	MIDDLE POTOMAC RIVER	Frederick	03/20/00	07/06/00	1	1287
UMON-115-R-2000	SANDY RUN	021403030244	Upper Monocacy River	MIDDLE POTOMAC RIVER	Frederick	03/20/00	06/26/00	1	117
UMON-117-R-2000	GRACEHAM RUN	021403030251	Upper Monocacy River	MIDDLE POTOMAC RIVER	Frederick	03/27/00	06/28/00	1	425
UMON-119-R-2000	BUZZARD BR	021403030244	Upper Monocacy River	MIDDLE POTOMAC RIVER	Frederick	03/20/00	07/05/00	1	1078
UMON-128-R-2000	HIGH RUN	021403030251	Upper Monocacy River	MIDDLE POTOMAC RIVER	Frederick	03/27/00	06/28/00	1	107
UMON-131-R-2000	CREAGERS BR	021403030245	Upper Monocacy River	MIDDLE POTOMAC RIVER	Frederick	03/28/00	06/28/00	1	342
UMON-132-R-2000	STEEP CR UT1	021403030243	Upper Monocacy River	MIDDLE POTOMAC RIVER	Frederick	03/28/00	07/06/00	1	241
UMON-134-R-2000	TURKEY CR	021403030259	Upper Monocacy River	MIDDLE POTOMAC RIVER	Frederick	03/28/00	06/26/00	1	1069
UMON-207-R-2000	LITTLE HUNTING CR	021403030258	Upper Monocacy River	MIDDLE POTOMAC RIVER	Frederick	03/20/00	06/26/00	2	5510
UMON-221-R-2000	HUNTING CR	021403030244	Upper Monocacy River	MIDDLE POTOMAC RIVER	Frederick	03/27/00	07/05/00	2	7991
UMON-229-R-2000	MUDDY RUN	021403030251	Upper Monocacy River	MIDDLE POTOMAC RIVER	Frederick	03/27/00	07/05/00	2	1327
UMON-230-R-2000	HUNTING CR	021403030250	Upper Monocacy River	MIDDLE POTOMAC RIVER	Frederick	03/27/00	06/27/00	2	6536
UMON-304-R-2000	FRIENDS CR	021403030251	Upper Monocacy River	MIDDLE POTOMAC RIVER	Frederick	03/28/00	06/27/00	3	7185
UMON-310-R-2000	PINEY CR	021403030251	Upper Monocacy River	MIDDLE POTOMAC RIVER	Carroll	03/28/00	09/07/00	3	11531
UMON-322-R-2000	HUNTING CR	021403030258	Upper Monocacy River	MIDDLE POTOMAC RIVER	Frederick	03/28/00	09/07/00	3	10746
UMON-413-R-2000	TOMS CR	021403030257	Upper Monocacy River	MIDDLE POTOMAC RIVER	Frederick	03/28/00	09/19/00	4	27658

Indicator Information

Site	FIBI	BIBI	PHI	Brook Trout Present	Black Water Stream
UMON-101-R-2000	1.00	3.44	20.47	0	0
UMON-103-R-2000	NR	2.78	35.91	0	0
UMON-106-R-2000	1.00	2.11	10.01	0	0
UMON-115-R-2000	NR	3.44	19.17	0	0
UMON-117-R-2000	1.86	3.22	19.17	0	0
UMON-119-R-2000	NR	3.67	91.43	1	0
UMON-128-R-2000	NS	1.44	NS	NS	NS
UMON-131-R-2000	1.57	2.56	4.24	0	0
UMON-132-R-2000	NR	1.67	12.01	0	0
UMON-134-R-2000	1.57	2.78	40.74	0	0
UMON-207-R-2000	3.86	3.00	NS	0	0
UMON-221-R-2000	3.86	4.33	80.31	0	0
UMON-229-R-2000	3.86	3.00	68.38	0	0
UMON-230-R-2000	3.57	4.33	90.24	0	0
UMON-304-R-2000	4.43	4.11	89.50	0	0
UMON-310-R-2000	3.86	2.56	31.34	0	0
UMON-322-R-2000	4.14	4.11	97.77	0	0

UMON-413-R-2000	3.57	3.22	94.03	0	0
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Catchment Land Use Information

Site	Percent Urban	Percent Agriculture	Percent Forest	Percent Other
UMON-101-R-2000	0.0	16.2	83.7	0.1
UMON-103-R-2000	0.0	86.7	13.3	0.3
UMON-106-R-2000	1.0	93.4	5.6	0.0
UMON-115-R-2000	0.0	0.0	100.0	0.0
UMON-117-R-2000	0.2	83.7	16.2	0.2
UMON-119-R-2000	0.0	0.5	99.3	0.2
UMON-128-R-2000	0.0	0.0	100.0	0.0
UMON-131-R-2000	2.7	90.4	6.6	0.8
UMON-132-R-2000	0.0	0.7	99.4	0.0
UMON-134-R-2000	0.0	0.3	99.6	1.6
UMON-207-R-2000	0.3	4.8	94.6	0.3
UMON-221-R-2000	5.8	13.5	80.5	0.9
UMON-229-R-2000	2.8	3.1	94.1	0.3
UMON-230-R-2000	0.3	9.9	89.7	1.0
UMON-304-R-2000	0.4	29.5	69.9	0.4

UMON-310-R-2000	2.0	81.3	15.8	1.3
UMON-322-R-2000	4.9	12.3	82.7	0.8
UMON-413-R-2000	1.6	20.8	77.2	0.9

Upper Monocacy River

Interpretation of Watershed Condition

- Watershed is very different in character on west side of Rt. 15 than on east side. Mountainous, mostly forested streams on west with higher gradient. Low gradient, farmland streams, more impacted on east side.
- Several sites in pastures where the cows have access - no riparian buffers (Sites 106, 310)
- Other problems included siltation, a few sites with high nitrate-nitrogen, historic channelization
- Several sites small, dry or with very little flow in summer (Sites 128, 131, 132)
- At site 134, all fish captured were small young-of-year; mostly shallow in pool/glide areas, nice riffles, crystal clear water
- Several sites in very good condition; Site 304 supports stocked trout

Upper Monocacy River

Water Chemistry Information

Site	Closed pH	Specific Cond.	ANC (ueq/L)	Cl (mg/L)	Nitrate-N (mg/L)	SO4 (mg/L)	P-P (mg/L)	TD-P (mg/L)	Ortho-P (mg/L)	Nitrite (mg/L)	Ammonia (mg/L)	TD-N (mg/L)	P-N (mg/L)	P-C (mg/L)	DOC (mg/L)	DO (mg/L)	Turbidity (NTUs)
UMON-101-R-2000	7.18	143.0	676.9	21.506	0.486	5.949	0.011	0.079	0.064	0.003	0.283	0.907	0.118	1.245	1.701	6.8	0.5
UMON-103-R-2000	7.14	144.2	529.1	6.618	1.775	22.128	0.002	0.013	0.005	0.004	0.022	2.203	0.047	0.404	4.533	6.0	3.5
UMON-106-R-2000	8.16	537.0	4381.9	13.934	8.902	17.957	0.003	0.009	0.003	0.000	0.000	9.117	0.062	0.486	1.077	7.2	1
UMON-115-R-2000	5.60	31.9	9.1	1.231	0.283	7.240	0.000	0.005	0.000	0.000	0.000	0.365	0.036	0.267	1.772	9.6	1.6
UMON-117-R-2000	7.19	131.8	495.3	10.700	2.920	7.946	0.003	0.029	0.016	0.000	0.022	3.329	0.058	0.580	7.075	6.3	7.2
UMON-119-R-2000	7.05	55.3	256.3	3.555	0.139	5.757	0.000	0.006	0.000	0.000	0.000	0.214	0.026	0.180	1.841	7.3	3.1
UMON-128-R-2000	5.23	21.5	11.1	1.068	0.402	2.769	0.000	0.004	0.000	0.000	0.009	0.482	0.016	0.038	0.827	NS	NS
UMON-131-R-2000	7.45	299.4	1217.9	34.501	2.089	22.560	0.027	0.047	0.025	0.057	0.138	2.677	0.113	0.801	8.278	6.9	9.9
UMON-132-R-2000	4.92	49.5	-9.9	8.915	0.000	5.843	0.000	0.003	0.000	0.000	0.000	0.038	0.003	0.054	1.456	5.7	0.3
UMON-134-R-2000	7.30	83.0	319.5	5.790	0.369	10.540	0.001	0.006	0.003	0.000	0.014	0.440	0.027	0.238	2.369	9.2	1
UMON-207-R-2000	6.98	80.6	339.9	8.523	0.225	6.246	0.002	0.008	0.003	0.000	0.000	0.303	0.039	0.388	1.220	8.6	6.6
UMON-221-R-2000	7.42	117.6	395.3	16.555	0.462	7.761	0.001	0.005	0.001	0.001	0.018	0.693	0.044	0.469	5.658	8.0	1.5
UMON-229-R-2000	7.23	76.7	274.4	10.238	0.309	4.553	0.003	0.005	0.001	0.000	0.024	0.491	0.025	0.356	1.715	7.7	2.2
UMON-230-R-2000	7.23	105.3	329.2	15.080	0.411	7.500	0.001	0.003	0.000	0.000	0.010	0.533	0.030	0.244	2.170	7.5	1.6
UMON-304-R-2000	7.75	143.2	574.4	16.539	0.701	13.875	0.001	0.010	0.008	0.000	0.013	0.884	0.019	0.264	2.199	7.3	5.1
UMON-310-R-2000	7.63	179.7	812.8	15.365	2.085	14.685	0.008	0.075	0.060	0.012	0.164	2.856	0.171	1.263	6.459	9.2	7.1
UMON-322-R-2000	7.61	138.7	483.3	21.025	0.455	7.555	0.004	0.010	0.008	0.000	0.017	0.600	0.073	0.773	2.484	8.6	3.3
UMON-413-R-2000	7.74	133.4	773.4	11.673	0.657	12.358	0.002	0.011	0.008	0.001	0.019	0.776	0.039	0.264	2.547	8.2	5

Physical Habitat Condition

Site	Riparian Buffer Width Left	Riparian Buffer Width Right	Adjacent Cover Left	Adjacent Cover Right	Instream Habitat Structure	Epifaunal Substrate	Velocity/ Depth Diversity	Pool/Glide/ Eddy Quality	Extent of Pools (m)	Riffle Run Quality	Extent of Riffles (m)	Embedded-ness	Shading	Trash Rating	Maximum Depth (cm)
UMON-101-R-2000	50	50	FR	FR	10	12	8	4	25	7	50	35	98	16	14
UMON-103-R-2000	14	22	CP	CP	11	11	6	10	65	8	15	35	95	17	24
UMON-106-R-2000	0	0	PA	PA	12	7	10	10	73	7	2	90	35	9	38
UMON-115-R-2000	50	50	FR	FR	12	17	7	5	60	6	20	25	98	20	15
UMON-117-R-2000	2	50	CP	LN	11	11	8	9	65	8	10	65	95	8	32
UMON-119-R-2000	50	50	SL	SL	17	18	15	16	35	15	45	25	90	20	73
UMON-128-R-2000	50	50	FR	FR	NS	NS	NS	NS	NS	NS	NS	NS	NS	20	NS
UMON-131-R-2000	0	0	PA	PA	9	10	5	10	75	4	5	45	75	6	42
UMON-132-R-2000	50	50	FR	FR	8	9	6	8	15	0	0	20	97	20	50
UMON-134-R-2000	3	50	PV	FR	13	18	8	7	35	14	40	35	90	19	32
UMON-207-R-2000	50	50	CP	OF	18	16	15	14	30	17	45		70	17	52
UMON-221-R-2000	18	5	PA	PV	17	16	12	10	35	18	50	30	75	16	42
UMON-229-R-2000	50	50	FR	FR	12	11	8	8	35	13	45	45	80	20	35
UMON-230-R-2000	50	24	FR	PA	18	20	16	15	20	19	70	20	55	15	54
UMON-304-R-2000	12	21	PV	PV	19	16	17	18	30	19	50	30	60	19	104
UMON-310-R-2000	0	0	PA	PA	12	8	12	12	70	7	7	45	20	15	55
UMON-322-R-2000	4	50	PA	FR	19	18	15	17	35	18	55	10	80	17	102
UMON-413-R-2000	50	23	FR	PV	17	17	14	13	30	16	55	20	45	19	54

Upper Monocacy River

Physical Habitat Modifications

Site	Buffer Breaks?	Surface Mine?	Landfill?	Channelization?	Erosion Severity Left	Erosion Severity Right	Bar Formation
UMON-101-R-2000	N	N	N	N	Mild	None	None
UMON-103-R-2000	N	N	N	N	None	None	Moderate
UMON-106-R-2000	Y	N	N	N	Mild	Mild	None
UMON-115-R-2000	N	N	N	N	None	None	None
UMON-117-R-2000	N	N	N	N	None	Mild	Minor
UMON-119-R-2000	Y	N	N	Y	None	Mild	Minor
UMON-128-R-2000	N	N	N	N	NS	NS	NS
UMON-131-R-2000	Y	N	N	N	None	None	Minor
UMON-132-R-2000	N	N	N	N	None	None	None
UMON-134-R-2000	N	N	N	Y	Mild	None	Minor
UMON-207-R-2000	N	N	N	N	None	None	Minor
UMON-221-R-2000	N	N	N	Y	None	None	Minor
UMON-229-R-2000	N	N	N	N	Mild	Mild	Severe
UMON-230-R-2000	N	N	N	N	None	None	Minor
UMON-304-R-2000	N	N	N	N	None	None	Minor
UMON-310-R-2000	Y	N	N	N	Severe	Moderate	Moderate
UMON-322-R-2000	N	N	N	N	None	Mild	Moderate
UMON-413-R-2000	N	N	N	N	Severe	None	Minor

Upper Monocacy River

Fish Species Present

BANDED KILLIFISH
BLACKNOSE DACE
BLUEGILL
BLUNTNOSE MINNOW
BROOK TROUT
BROWN BULLHEAD
BROWN TROUT
CENTRAL STONEROLLER
COMELY SHINER
COMMON SHINER
CREEK CHUB
CREEK CHUBSUCKER
CUTLIPS MINNOW
FALLFISH
FANTAIL DARTER
FATHEAD MINNOW
GOLDEN SHINER
GOLDFISH
GREEN SUNFISH
GREENSIDE DARTER
LARGEMOUTH BASS
LONGEAR SUNFISH
LONGNOSE DACE
MARGINED MADTOM
MOSQUITOFISH
MOTTLED SCULPIN
NORTHERN HOGSUCKER
PEARL DACE
POTOMAC SCULPIN
PUMPKINSEED
REDBREAST SUNFISH
ROCK BASS
ROSYIDE DACE
SILVERJAW MINNOW
SMALLMOUTH BASS
SPOTFIN SHINER
SPOTTAIL SHINER
SUNFISH HYBRID
TESSELLATED DARTER
WHITE SUCKER
YELLOW BULLHEAD

Exotic Plants Present

MULTIFLORA ROSE
THISTLE

Benthic Taxa Present

ACENTRELLA
ACRONEURIA
AGABUS
ALLOCAPNIA
AMELETUS
AMPHINEMURA
ANCHYTARSUS
ANTOCHA
ARGIA
BAETIDAE
BAETIS
BRILLIA
CAPNIIDAE
CERATOPOGONIDAE
CHIRONOMINI
CHLOROPERLIDAE
CRANGONYCTIDAE
CAECIDOTEA
CERATOPOGON
CHAETOCLADIUS
CHEUMATOPSYCHE
CHIMARRA
CLADOTANYTARSUS
CLINOCERA
CLIOPERLA
CNEPHIA
CONCHAPELOPIA
CORYNONEURA
CRANGONYX
CRICOTOPUS
CRICOTOPUS/ORTHOCLADIUS
CRYPTOCHIRONOMUS
CURA
DIAMESINAE
DOLICHOPODIDAE
DYTISCIDAE
DIAMESA
DICRANOTA
DIPLECTRONA
DIPLOCLADIUS
DOLOPHILODES
DRUNELLA
ENCHYTRAEIDAE
ENALLAGMA
EPEORUS
EPHEMERELLA
EUKIEFFERIELLA

EURYLOPHELLA
GOMPHIDAE
HEPTAGENIIDAE
HELENIELLA
HETEROTRISSOCLADIUS
HEXATOMA
HYDROBAENUS
HYDROPSYCHE
ISONYCHIA
ISOPERLA
ISOTOMURUS
KRENOPELOPIA
LEPTOPHLEBIIDAE
LEUCTRIDAE
LUMBRICULIDAE
LEPIDOSTOMA
LEUCTRA
LIMNOPHYES
MACRONYCHUS
MICRASEMA
MICROPSECTRA
NAIDIDAE
NEMOURIDAE
NEOPHYLAX
NIGRONIA
ORTHOCLADIINAE
OPTIOSERVUS
ORCONECTES
ORTHOCLADIINAE A
OULIMNIUS
PERLIDAE
PERLODIDAE
PYRALIDAE
PARALEPTOPHLEBIA
PARAMETRIOCNEMUS
PERICOMA
PHYSELLA
POLYPEDILUM
PROSIMULIUM
PROSTOIA
PSEPHENUS
PSYCHOMYIA
PYCNOPSYCHE
RHEOCRICOTOPUS
RHEOTANYTARSUS
RHYACOPHILA
SPHAERIIDAE
SIMULIUM
STAGNICOLA
STEGOPTERNA
STEMPELLINELLA

STENACRON
STENELMIS
STENONEMA
STYGONECTES
SWELTS
SYMPOSIACLADIUS
SYMPOTTHASTIA
TIPULIDAE
TUBIFICIDAE
TURBELLARIA
TAENIOPTERYX
TANYTARSUS
THIENEMANNIELLA
THIENEMANNIMYIA
TIPULA
TVETENIA
ZAVRELIMYIA

Herpetofauna Present

BULLFROG
EASTERN BOX TURTLE
EASTERN GARTER SNAKE
GREEN FROG
NORTHERN DUSKY SALAMANDER
NORTHERN SPRING SALAMANDER
NORTHERN TWO-LINED SALAMANDER
NORTHERN WATER SNAKE
PICKEREL FROG

5 TEMPORAL CHANGES IN PARAMETER ESTIMATES FOR 8-DIGIT WATERSHEDS

As each round of statewide sampling by the MBSS (or the Survey) is conducted at regular intervals over time, temporal changes (trends) in the stream condition statewide and for individual 8-digit watersheds can be evaluated. Such monitoring data are necessary to assessing whether implementation of Total Maximum Daily Loadings (TMDLs) and other restoration measures are effective in achieving or maintaining water quality standards (or in effecting other improvements in stream quality). The MBSS also provides information on physical parameters that can be used to track changes in habitat conditions and link such changes to trends in water quality.

This chapter compares results for the first year of MBSS Round Two with data from Round One (1995-1997). Nine of the 8-digit watersheds sampled in 2000 also had more than 10 spring samples in one or two years of MBSS Round One. Data from two or three years are insufficient to estimate trends, but can be used to assess differences. The mean fish and benthic IBI scores were estimated as well as the percentage of stream miles with fish or benthic IBI less than 3 for each year, along with the 90% confidence intervals. The combined IBI was not employed in the inter-annual variability analysis because comparisons could have obscured real differences apparent in individual fish or benthic IBIs. No significant yearly differences in mean fish and benthic IBI scores were observed. In general, the mean IBI scores were stable over time (Table 5-1). The yearly estimated confidence intervals for percentage of stream miles with fish or benthic IBI scores less than 3 overlapped for all watersheds except for the Upper Monocacy which had an interval estimate of 19.9 to 60.8 % for the benthic IBI in 2000 as compared to the 66.6 to 90.5% interval in 1996 (Table 5-2).

The percentage of stream miles with certain chemical and physical habitat characteristics was also estimated. Specifically, the percentages of stream miles with the following were compared:

- Urban land use > 25% of catchment area
- Agricultural land use > 75% of catchment area
- Physical Habitat Index (PHI) < 42 (poor to very poor)
- No riparian buffer

The interval estimates for these parameters were used to “ground truth” results from the two rounds of MBSS. These parameters would generally be subject to minimal

changes over a few years, but will be important for tracking long-term changes in stream habitat. In particular, urban and agricultural lands were derived from the same MRLC data and thus should not exhibit significant change. Any observed changes would result from the selection of different random sampling sites, rather than to real differences between years.

In general, the interval estimates for these habitat parameters overlap across years, as would be expected (Table 5-3). Significant differences between years were observed for only two watersheds. For the Patapsco River Lower North Branch, the estimated percentage of stream miles with riparian buffers in 2000 was significantly lower than for 1995. For Little Patuxent River, the estimates of percentage of stream miles with PHI scores < 42 or with no buffer were significantly lower in 2000 as compared to 1997 estimates. These results suggest that the samples in the two years were located in markedly different streams habitats by chance, and are not likely to reflect real changes in habitat between the years. For 90% confidence intervals, the true percentage of stream miles would be outside the interval estimate in 10% of the cases. Thus, when a large number of comparisons are made, as for this report, some false positives are expected.

The physical habitat for the sites sampled influence the fish and benthic communities. Hence, when comparing estimates of percentage of stream miles with IBI < 3 across years, it is important to evaluate whether the samples were collected in similar habitats. On average, simple random sampling results in the number of sites in each habitat class being proportional to the fraction of streams having that habitat. However, any individual selection of sites could, by chance, result in a higher sampling density in one habitat, especially for low sample sizes. For example, the lower estimate of percentage of stream miles with benthic IBI < 3 in Lower Monocacy watershed in 2000 as compared to 1996 could result from the lower proportion of sampling sites with no riparian buffer in 2000, and may not necessarily be a result of real changes in stream condition.

The detection of trends in mean IBI scores statewide, or for individual watersheds requires a time series of data. Although exact statistics can be obtained for ≥ 2 , a minimum of four or more rounds of samples collected over time is required to obtain meaningful results using the non-parametric Mann-Kendall test for trends (Gilbert 1987,

Hirsch et al. 1982). While it is true that evaluating some fixed sites that are stable in terms of land use and other stressors would provide additional information on year-to-year variabilities across a wide range of conditions,

resources were not available for this type of supplemental effort during the 2000 sampling year.

Table 5-1. Variability in mean fish and benthic IBI scores between the 1995-1997 MBSS and the 2000 MBSS. Watersheds shown are those that contained 10 or more sites in the 1995-1997 MBSS.						
Watershed	FIBI	Lower 90%	Upper 90%	BIBI	Lower 90%	Upper 90%
Casselman River 1995	3.78	3.18	4.38	4.02	3.45	4.49
Casselman River 1997	3.67	2.94	4.40	3.28	0.55	5.57
Casselman River 2000	2.63	1.94	3.32	3.38	2.72	3.93
Fifteen Mile Creek 1995	2.18	1.78	2.59	3.18	2.84	3.45
Fifteen Mile Creek 2000	3.00	1.95	4.05	3.82	3.51	4.08
Upper Monocacy River 1996	3.05	2.40	3.70	2.12	1.67	2.49
Upper Monocacy River 2000	2.92	2.33	3.51	3.10	2.77	3.37
Brighton Dam 1997	2.86	2.59	3.13	3.53	3.20	3.80
Brighton Dam 2000	3.54	3.25	3.83	3.69	3.27	4.04
Little Patuxent River 1997	2.70	1.87	3.53	2.10	1.69	2.46
Little Patuxent River 2000	3.37	3.05	3.69	2.79	2.32	3.18
South Branch Patapsco 1995	4.23	0.77	7.70	3.43	2.67	4.06
South Branch Patapsco 1996	3.62	2.84	4.39	2.97	2.60	3.28
South Branch Patapsco 2000	3.63	3.28	3.98	3.71	3.33	4.03
Liberty Reservoir 1995	3.94	3.08	4.80	3.55	2.78	4.19
Liberty Reservoir 1996	3.88	2.35	5.41	2.73	1.84	3.48
Liberty Reservoir 2000	3.98	3.84	4.12	3.60	3.37	3.80
Patapsco River Lower North Branch 1995	2.38	1.35	3.42	2.66	2.16	3.08
Patapsco River Lower North Branch 2000	2.64	1.99	3.29	2.84	2.59	3.05
Upper Choptank 1997	3.07	1.40	4.74	2.04	1.34	2.62
Upper Choptank 2000	3.18	2.74	3.62	2.63	2.19	2.99

Table 5-2. Variability in fish and benthic IBI scores between the 1995-1997 MBSS and the 2000 MBSS. Watersheds shown are those that contained 10 or more sites in the 1995-1997 MBSS.

Watershed	Number of Spring Sites	Percentage of stream miles with FIBI < 3	Lower 90% Confidence Limit	Upper 90% Confidence Limit	Percentage of stream miles with BIBI < 3	Lower 90% Confidence Limit	Upper 90% Confidence Limit
Casselman River 1995	11	22.7	3.3	47.0	3.4	0.5	36.4
Casselman River 1997	13	3.9	0.3	30.5	8.4	0.5	32.6
Casselman River 2000	10	60.0	30.4	85.0	30.0	8.7	60.7
Fifteen Mile Creek 1996	20	30.6	14.0	50.8	34.0	17.7	55.8
Fifteen Mile Creek 2000	10	42.9	12.9	61.9	10.0	0.5	39.4
Upper Monocacy 1996	36	29.1	18.2	45.5	80.9	66.6	90.5
Upper Monocacy 2000	18	38.5	16.6	54.5	38.9	19.9	60.8
Brighton Dam 1997	16	54.9	33.3	77.3	17.1	5.3	41.7
Brighton Dam 2000	11	11.1	0.6	42.9	18.2	3.3	47.0
Little Patuxent River 1997	14	62.1	39.0	84.7	86.0	61.5	97.4
Little Patuxent River 2000	13	25.0	17.9	52.7	53.9	28.7	77.6
South Branch Patapsco 1995	11	0.0	0.0	23.9	43.9	20.0	72.9
South Branch Patapsco 1996	18	0.0	0.0	25.3	39.4	8.0	43.9
South Branch Patapsco 2000	10	12.5	0.6	47.1	9.1	0.5	36.4
Liberty Reservoir 1995	19	11.0	1.9	29.6	12.0	4.5	35.9
Liberty Reservoir 1996	18	0.0	0.0	15.3	54.8	34.1	75.6
Liberty Reservoir 2000	16	0.0	0.0	19.3	18.8	5.3	41.7
Patapsco River Lower North Branch 1995	14	39.8	20.6	67.8	66.5	39.0	84.7
Patapsco River Lower North Branch 2000	14	50.0	22.2	77.8	53.3	30.0	75.6
Upper Choptank 1997	14	37.0	15.3	61.0	79.9	53.4	93.9
Upper Choptank 2000	14	30.0	8.7	60.7	57.1	32.5	79.4

Table 5-3. Variability in certain physical and chemical variables between the 1995-1997 MBSS and the 2000 MBSS. Watersheds shown are those that contained 10 or more sites in the 1995-1997 MBSS.																
Watershed	Number of Spring Sites	Percentage of Stream Miles with Urban Land > 25%	Lower 90% Confidence Limit	Upper 90% Confidence Limit	Percentage of Stream Miles with Agricultural Land > 25%	Lower 90% Confidence Limit	Upper 90% Confidence Limit	Percentage of Stream Miles with Nitrate Nitrogen > 7 mg/L	Lower 90% Confidence Limit	Upper 90% Confidence Limit	Percentage of Stream Miles with PHI < 42	Lower 90% Confidence Limit	Upper 90% Confidence Limit	Percentage of Stream Miles With No Riparian Buffer	Lower 90% Confidence Limit	Upper 90% Confidence Limit
Casselman River 1995	11.0	0.0	0.0	23.8	0.0	0.0	23.8	0.0	0.0	23.8	49.8	20.0	72.9	22.7	3.3	47.0
Casselman River 1997	13.0	0.0	0.0	20.6	0.0	0.0	20.6	0.0	0.0	20.6	59.8	28.7	77.6	4.2	0.4	31.1
Casselman River 2000	10.0	0.0	0.0	25.9	0.0	0.0	25.9	0.0	0.0	25.9	20.0	3.7	50.7	20.0	3.7	50.7
Fifteen Mile Creek 1996	20.0	0.0	0.0	13.9	0.0	0.0	13.9	0.0	0.0	13.9	93.3	71.7	98.2	13.0	4.2	34.4
Fifteen Mile Creek 2000	10.0	0.0	0.0	25.9	0.0	0.0	25.9	0.0	0.0	25.9	50.0	19.3	80.7	10.0	0.5	39.4
Upper Monocacy 1996	36.0	0.0	0.0	8.0	34.3	20.5	48.3	5.6	1.0	16.5	47.2	32.8	62.1	45.5	30.2	59.4
Upper Monocacy 2000	18.0	0.0	0.0	13.3	28.6	13.2	48.7	5.6	0.3	23.8	56.3	33.3	77.3	16.7	4.7	37.7
Brighton Dam 1997	16.0	0.0	0.0	17.1	36.3	17.8	60.9	17.1	5.3	41.7	17.4	5.4	41.9	17.1	0.0	17.1
Brighton Dam 2000	11.0	0.0	0.0	23.8	45.5	20.0	72.9	0.0	0.0	23.8	9.1	0.5	36.4	0.0	0.0	23.8
Little Patuxent River 1997	14.0	72.0	46.0	89.6	0.0	0.0	19.3	0.0	0.0	19.3	61.9	39.0	84.7	50.0	26.4	73.6
Little Patuxent River 2000	13.0	21.4	6.1	46.6	7.1	0.4	29.7	0.0	0.0	20.6	7.7	0.4	31.6	0.0	0.0	20.6
South Branch Patapsco 1995	11.0	0.0	0.0	23.8	45.6	20.0	72.9	32.8	13.5	65.0	37.2	13.5	65.0	47.4	19.9	72.9
South Branch Patapsco 1996	18.0	0.0	0.0	15.3	60.2	27.3	83.2	0.0	0.0	15.3	22.5	8.2	44.2	37.1	20.0	60.8
South Branch Patapsco 2000	10.0	0.0	0.0	22.1	50.0	24.5	75.5	9.1	0.5	36.4	27.3	7.9	56.4	9.1	0.5	36.4
Liberty Reservoir 1995	19.0	0.0	0.0	14.6	40.5	23.0	63.2	12.4	4.5	35.9	15.7	4.9	36.2	24.4	11.0	47.6
Liberty Reservoir 1996	18.0	0.0	0.0	15.3	52.1	34.1	75.6	16.2	4.7	37.7	21.8	8.0	43.9	39.7	19.9	60.8
Liberty Reservoir 2000	16.0	0.0	0.0	17.1	43.8	22.7	66.7	0.0	0.0	17.1	6.3	0.3	26.4	6.3	0.3	26.4
Patapsco River L N Branch 1995	14.0	84.7	61.5	97.4	0.0	0.0	19.3	0.0	0.0	19.3	39.8	20.6	67.5	48.3	21.6	68.7
Patapsco River L N Branch 2000	14.0	62.5	39.1	82.2	6.3	0.3	26.4	0.0	0.0	18.1	7.7	0.4	31.6	0.0	0.0	18.1
Upper Choptank 1997	14.0	0.0	0.0	19.3	3.0	0.4	29.7	11.2	2.6	38.5	57.7	32.5	79.4	0.0	0.0	19.3
Upper Choptank 2000	14.0	0.0	0.0	19.3	0.0	0.0	23.8	7.1	0.4	29.7	30.8	11.3	57.3	7.1	0.4	29.7

6. SENTINEL SITES

Round Two of the Maryland Biological Stream Survey (MBSS or the Survey) provides an opportunity to examine trends in stream conditions over time. However, to accurately assess temporal trends, it is necessary to differentiate between changes that result from anthropogenic influences and those that result from natural variation. In natural streams, variability in ecological condition between years should be attributable only to variations in precipitation and temperature regimes, as well as to biotic interactions among native species. Therefore, annual monitoring information from minimally disturbed sites (referred to as Sentinel sites) is the best means of interpreting the degree to which changes in biological indicator scores result from natural variability. Understanding the variability of disturbed sites is also important for evaluating status and trends, and can be addressed by monitoring fixed disturbed sites as well. Assuring that stressor conditions do not change at disturbed sites over time is more difficult than for natural sites and the MBSS is not currently sampling such fixed sites. Although there are no longer any pristine streams in Maryland, monitoring a set of the best remaining streams offers a reasonable alternative. In 2000, the Survey began annual sampling at a set of Sentinel sites. The following sections describe the methods used to select Sentinel sites and presents the results of the sampling in 2000.

6.1 METHODS

To ensure that sites with minimal anthropogenic impacts were selected as long-term Sentinel sites, a three tier land use, water quality, and biological community criteria was established and applied to all sites sampled by the MBSS from 1995 to 1999. The following list of Tier 1 criteria was used to identify candidate Sentinel sites:

- No evidence of acid mine drainage in the site catchment
- Sulfate < 50 mg/l
- pH > 6.0 or DOC > 8.0 mg/l (i.e., pH could be < 6 if representing a naturally acidic blackwater stream)
- Nitrate nitrogen < 4.0 mg/l
- Percent forested land use > 50% of catchment area
- Combined Biotic Index (CBI, calculated as the simple mean of FIBI and BIBI scores) > 3.0, or coldwater or blackwater stream

In addition, streams not previously sampled quantitatively by MBSS, but judged to meet the above criteria, were included in the initial pool of candidate sites.

Candidate Sentinel sites were grouped according to stream order and geographic region (Coastal Plain-Eastern Shore, Coastal Plain-Western Shore, Eastern Piedmont, or Highlands) to facilitate representation of small, medium, and large streams throughout Maryland. Subsequently a Tier 2 list of provisional sites was compiled using the following criteria:

- minimum of 5 sites in each geographic region
- minimum of 5 sites in each stream order
- as well as the percentage of forested land use (> 50%)
- the larger amount of the catchment that was located within protected lands (e.g., the Nature Conservancy Preserves and State Forests), and
- sampling site itself was located on public land.

This screening ensured that sites were minimally disturbed and likely to remain so for the foreseeable future.

The provisional Sentinel sites consisted of six or seven sites in each of the four geographic regions that appeared to have the least human disturbance and the least likelihood of changing in the future from human-related activities in their catchments. To make the final Tier 3 selection of Sentinel sites, biologists reviewed information from external sources and conducted site visits (where needed to confirm land use or other watershed conditions).

6.2 RESULTS

Of the nearly 1000 sites sampled by the MBSS in Round One (in 1995-1997), 189 met the criteria for candidate Sentinel sites (15 Coastal Plain-Eastern Shore, 44 Coastal Plain-Western Shore, 16 Eastern Piedmont, and 114 Highlands) (Appendix Table D-1). The list of candidate sites was reduced to 25 final sites (with six or seven sites in each region) by considering stream size, geographic distribution, the percent of forested land use within the catchment, whether or not the site was located on protected lands, and confirmation from a site visit that obvious anthropogenic influences were minimal. Two additional sites on The Nature Conservancy property that had not

previously been sampled by the MBSS were added to this list: one on Nassawango Creek and one on Sideling Hill Creek (to be sampled in 2001). Both streams were added to the list because existing ecological and land use information warranted their inclusion. Appendix Table D-2 provides the final list of 27 Sentinel sites that were sampled during the 2000 sampling season.

Of the 294 sites sampled by the Survey in 2000 (including the 27 Sentinel sites), 91 met the criteria used to identify candidate Sentinel sites (12 in Coastal Plain-Eastern Shore, 20 Coastal Plain-Western Shore, 18 Eastern Piedmont, and 41 Highlands) (Appendix Table D-3). Of the 27 Sentinel sites, 24 continued to meet the minimum Sentinel site criteria. NASS-301-S-2000 was excluded because forested land use did not exceed 50% (42% forested land use). Two additional sites (WCHE-086-S-2000 and WYER-118-S-2000) were excluded because the Combined Biotic Index (CBI) score in 2000 did not exceed 3.0 (and these sites were not coldwater or blackwater streams).

To ensure that adequate numbers of Sentinel sites are available in each geographic region, new sites sampled in 2000 that met the candidate criteria were considered as potential substitutes for the excluded Sentinel sites. Site WCHE-086-S-2000 (Coastal Plain-Western Shore) was replaced with site STMA-104-R-2000. This site is located on Warehouse Run in Saint Mary's County, a stream that has excellent water quality conditions, high biological index scores, and a catchment dominated by forested land use. WYER-118-S-2000 (Coastal Plain-Eastern Shore) was replaced with site CORS-102-R-2000. This site is located on Kirby Creek in Queen Anne's County, a blackwater stream with good water quality and a catchment dominated by forested land use (Appendix Table D-3). Because NASS-301-S-2000 was located on a minimally disturbed, blackwater stream, a replacement site was selected downstream in the watershed so that the percent forested land use would meet the minimum criteria. In future years, other Sentinel sites may be replaced if new anthropogenic impacts are identified.

Although the years in which data were collected at each Sentinel site varied (1995, 1996, 1997, or 2000), values for many of the parameters were not dramatically different between the initial visit and the visit in 2000 (Appendix Table D-4). The most notable changes included variations in blackwater or brook trout designation for a site. For example, UMON-288-S-2000 and JONE-109-S-2000 underwent changes in brook trout designations, based on the

presence of brook trout in the sample one year and its absence in the other year.

These changes in designation indicate that it is important to consider other available data in assigning coldwater or blackwater designations. For example, the use of temperature logger records will likely prove a more reliable way to identify coldwater streams than relying on the capture of a single species. (This method may also identify historically coldwater streams from which trout have been extirpated for reasons other than temperature.) In addition, field observations and site-specific knowledge regarding blackwater conditions can augment the strictly water-chemistry based definition, which uses single-point-in-time data that may not account for slight variations in DOC or pH levels.

6.3 DISCUSSION

The existing Sentinel site network contains some of the best freshwater streams in Maryland, (i.e., minimally disturbed and least likely to change in the future from human-related activities) includes first- through third-order streams within each geographic region. However, noticeable differences exist in the quality of streams located in each of the four geographic regions. The Highlands stratum contains seven streams with no apparent anthropogenic impacts. All seven have excellent water quality conditions, good biological index scores, and a catchment dominated by forested land use (76% or greater; Appendix Table D-4). Conversely, it was difficult to identify minimally disturbed sites in the Coastal Plain-Western Shore, Eastern Piedmont, and especially the Coastal Plain-Eastern Shore. Although some sites met the minimum criteria for candidate Sentinel sites, many suffered from significant anthropogenic impacts (mostly resulting from agricultural land use).

The utility of the Sentinel network will depend upon whether land use changes or other potential impacts arise in the Sentinel site catchments. Future sampling will determine whether high quality conditions continue to exist at these locations and they should remain as part of the Sentinel site network. These Sentinel sites will be sampled annually to quantify natural variability. Sentinel sites may be added or replaced in the future to ensure that adequate numbers of undisturbed sites are available to detect trends in site condition. It will likely take several years of data for the Sentinel site network to estimate the temporal variability in the best remaining streams in Maryland.

7. APPLYING THE MARYLAND INTERIM BIOCRITERIA FRAMEWORK TO MBSS 2000 DATA

To meet the requirements of the Clean Water Act, the State of Maryland is in the process of developing biological criteria (biocriteria) for evaluating its waters. As an initial step, the Maryland Department of the Environment (MDE), with the assistance of the Biological Criteria Advisory Committee, has developed an interim framework for the application of biocriteria to the State's water quality inventory (305(b) report) and list of impaired waters (303(d) list). Biological indicators of aquatic condition are the basis of these interim biocriteria.

At present, the proposed biocriteria for wadeable, non-tidal (first- to fourth-order) streams rely on two biological indicators from the MBSS (or Survey), the fish Index of Biotic Integrity (IBI) and the benthic IBI. The interim framework approach is a tool to identify impaired waters at the watershed level using Maryland 8-digit watershed or 12-digit subwatershed designations. In addition to these indices, the Survey provides extensive assessment data on Maryland's non-tidal streams that can aid in identifying stressors or potential sources of degradation. The State is also considering how data from other programs can be used to supplement the MBSS data, thus providing more information for determining watershed impairment status and identifying the sources and causes of impairments.

In this chapter, we describe the results of applying the interim biocriteria framework to MBSS data collected in 2000. This analysis provides a preliminary evaluation of the MBSS data using the interim biocriteria framework. Our analysis is intended to assist the State in preparing the 305(b) report and 303(d) list; however, our results are not final determinations of designated use support.

7.1 METHODS FOR APPLYING BIOCRITERIA

Data from more than 200 sample locations in the watersheds sampled in 2000 were analyzed. Fish and benthic IBI scores served as the bioassessment tools for evaluating sites and watersheds that fail to meet proposed interim biocriteria framework. Ultimately, for locations identified as not achieving the proposed IBI threshold values, follow-up analysis of other biological, water chemistry, physical habitat, and land use data, local knowledge, and field observations should be used to identify likely stressors. The effort is currently beyond the annual scope of the MBSS and is being considered as supplemental monitoring by MDE.

The interim framework proposes two geographic resolutions at which impaired waters would be listed: Maryland 8-digit watersheds and 12-digit subwatersheds. Decision rules currently proposed in the interim biocriteria framework were employed in our analysis, as outlined below. Note that these decision rules have not been formally proposed or accepted by the State and are still being developed.

As discussed in Section 3.1, the following types of sites were not rated:

- If upstream catchment area was < 300 acres, the fish IBI was not rated.
- If brook trout were present and fish IBI would be < 3, the fish IBI was not rated, but conditions were considered satisfactory because brook trout are normally indicators of high quality waters.
- If site was a blackwater stream (defined operationally as dissolved organic carbon (DOC) > 8 mg/l and either pH < 5 or acid neutralizing capacity (ANC) < 200 $\mu\text{eq/l}$) and fish IBI would be < 3, the fish IBI was not rated.

In addition, prior to application of the biocriteria framework, individual site results were reviewed by MBSS professional biologists (including program managers, QC Officer, and field crew leaders) to ascertain whether any sites should be excluded from this evaluation owing to special sampling circumstances or unusual natural site conditions. Provisions in the interim biocriteria framework recognize that the biocriteria are not applicable under certain conditions and that the use of best professional judgment is appropriate to assess whether particular conditions might result in spurious conclusions. Field data, notes, and site photographs aided in the review session. For any site for which a fish and/or benthic IBI was determined to be not applicable, the site assessment for that IBI was deemed "not rated" and appropriate justification was recorded in the data file.

In addition to the core MBSS sampling within 18 primary sampling units (PSUs including single 8-digit watersheds or combinations of the smallest of these watersheds), results from the Lower Monocacy PSU were analyzed. Lower Monocacy had been previously flagged using Round One data as requiring more data to make a determination of impairment status. Lower Monocacy was re-sampled in

2000 via random site selection and field methods identical to those of the core Survey.

7.1.1 Screening of 8-digit Watersheds

The framework specifies that data from at least 10 sites are needed within an 8-digit watershed in order to evaluate stream status at the 8-digit level. In watersheds with 10 benthic IBI scores but < 10 fish IBI scores, the benthic IBI alone was used for the 8-digit analysis. The number of sites sampled in each watershed was a compromise between the desired precision of estimates and the need for extensive spatial covering, given limited monitoring resources. Even imprecise estimates of condition can be used to target future sampling away from watersheds with good estimates and toward these where greater precision may provide conclusions.

Of the 19 PSUs sampled in 2000, four were "combined watersheds", including more than one 8-digit watershed apiece. These were not assessed at the 8-digit level, because of insufficient sample size within individual 8-digit watersheds. Possible impairments in these areas were to be picked up in 12-digit subwatershed analysis.

Where sufficient data were available within an 8-digit watershed (at least 10 sites with IBI scores), mean IBIs and one-sided 90% confidence interval values were calculated from the data as follows:

if IBI_{mean} is < 3 , $CL_{Upper} = IBI_{mean} + (z * SE)$, or

if IBI_{mean} is ≥ 3 , $CL_{Lower} = IBI_{mean} - (z * SE)$

Where

CL_{Upper} = upper confidence limit

CL_{Lower} = lower confidence limit

z = normal variate (in this case, $z = 1.28$ for one-sided 90% confidence interval, assuming a normal distribution for mean IBI)

SE = standard error of the mean = $\frac{sd}{\sqrt{n}}$, where sd = standard deviation and

n = number of sites (here, $n \geq 10$)

Following the current guidelines of the interim biocriteria framework, our preliminary analysis applied the following rules to give one of three ratings for 8-digit watersheds:

- **Does not meet criteria:** If the mean and upper bound of the one-sided 90% confidence interval (CL_{Upper}) of either index (FIBI or BIBI) is less than 3.0, the 8-digit watershed is listed as failing to meet the proposed criteria.
- **Meets criteria:** If the mean and lower bound of the one-sided 90% confidence interval (CL_{Lower}) of both indices (FIBI and BIBI) are greater than or equal than 3.0, the 8-digit watershed is listed as meeting the proposed criteria.
- **Inconclusive:** All other cases are inconclusive.

Pending further analysis, watersheds that **do not meet criteria** would be candidates for state reporting as "not supporting aquatic life uses" or "impaired"; watersheds that **meet criteria** would be candidates for reporting as "fully supporting aquatic life uses" or "unimpaired". Watersheds labeled as **inconclusive** may need further evaluation.

Even within 8-digit watersheds that meet criteria, particular constituent subwatersheds may not. Also, within 8-digit watersheds that are inconclusive, particular 12-digit subwatersheds within them fail to meet criteria. The 12-digit subwatershed analysis is described below.

7.1.2 Screening of 12-digit Subwatersheds

Data from individual sites are used to flag 12-digit subwatersheds that may be impaired. One-sided 90% confidence intervals associated with single samples are calculated using an average coefficient of variation (cv) of the IBIs as derived from previous analysis of IBI variability ($cv = 0.08$; Roth et al. 2001). Confidence intervals around scores for individual samples are calculated as follows:

if IBI is < 3 , $CL_{Upper} = IBI + (z * SE_{EST})$, or

if IBI is ≥ 3 , $CL_{Lower} = IBI - (z * SE_{EST})$

where

CL_{Upper} = upper confidence limit

CL_{Lower} = lower confidence limit

z = normal variate (in this case, $z = 1.28$ for one-sided 90% confidence interval, assuming a normal distribution for mean IBI)

$$SE_{EST} = \text{estimated standard error of the mean} = IBI \times \frac{cv}{\sqrt{n}} \text{ (in most cases, } n=1 \text{)}$$

Following the guidelines of the interim biocriteria framework, our preliminary analysis applied the following rules to give one of three ratings for 12-digit subwatersheds:

- **Does not meet criteria:** If for any site, the value and upper bound of the one-sided 90% confidence interval (CL_{Upper}) of either index (FIBI or BIBI) is less than 3.0, the 12-digit subwatershed is listed as failing to meet the proposed criteria
- **Meets criteria:** If for all sites, the value and lower bound of the one-sided 90% confidence interval (CL_{Lower}) of both indices (FIBI and BIBI) are greater than or equal than 3.0, the 12-digit subwatershed is listed as meeting the proposed criteria.
- **Inconclusive:** All other cases are inconclusive.

Note that this list of site data provides a snapshot of conditions in the sampled segments at one point in time. It does not necessarily reflect conditions throughout a given area. Further investigation may more fully characterize particular stream reaches or watersheds, but this level of effort is beyond the current scope of the MBSS.

7.2 RESULTS OF APPLYING BIOCRITERIA

7.2.1 Provisional Ratings for 8-digit Watersheds

Mean fish IBI, mean benthic IBI, and one-sided confidence intervals for each of the 15 8-digit watersheds sampled in MBSS 2000 (with enough sample sites) are depicted in Figure 7-1. Applying the decision rules above, only the benthic IBI in Upper Choptank watershed had a 90% confidence interval less than 3.0, resulting in an overall status of “fail” for this watershed alone. In all, 3 watersheds passed and 6 were inconclusive (Table 7-1, Figure 7-2). Note that 5 watersheds that originally had 10 or more sites were actually not able to be rated because after site review excluded sites where IBIs were not applicable, the minimum number of sites was not met.

7.2.2 Provisional Ratings for 12-digit Subwatersheds

The PSUs sampled in MBSS 2000 contained 264 12-digit subwatersheds. Excluding the subwatersheds with no sites, the mean number of sites per subwatershed was 1.7. Table 7-2 and Figure 7-3 show preliminary results from the application of the proposed biocriteria framework to these subwatersheds. For clarity of presentation, all 12-digit subwatersheds were compared with the biocriteria, regardless of the status of the 8-digit watershed that contained them. Note that for management purposes, if an impaired 12-digit subwatershed falls within a 8-digit watershed that was already listed as impaired, plans to improve watershed condition would be prepared at the 8-digit level.

Table 7-2 lists all 12-digit subwatersheds grouped by 8-digit watershed; the number of sites per subwatershed that passed, were inconclusive, or failed to meet criteria; and the overall 12-digit status based on the decision rules described above. Of the 264 12-digit subwatersheds, 134 were not sampled in MBSS 2000. Of the remaining 130 subwatersheds (regardless of status of the larger 8-digit watersheds), 69 failed, 32 passed, 22 were inconclusive and 7 were not rated because sites were removed during the site review process.

When combined with results of the 8-digit watershed assessments (Table 7-3, Figure 7-4), 9 of the failing subwatersheds fell within failing 8-digit watersheds, and thus would be managed at the 8-digit level. The remaining 60 would be candidates for listing at the 12-digit level. Also, 7 of the 22 inconclusive subwatersheds fell within failing or inconclusive 8-digit watersheds, and would presumably be handled at the 8-digit level.

The majority of failing 12-digit subwatersheds were based on a single failing site. Of the 69 subwatersheds failing, 54 failures were based on one failing site, 13 were based on two failing sites, and 2 were based on 3-5 failing sites. It is important to note that although the State intends to use single-site data as a screening tool to flag subwatersheds (and to avoid missing waters that are impaired), data from a single site do not necessarily represent conditions throughout the subwatershed. Although a single site may not be representative of an entire subwatershed, the State believes it more appropriate to address impairments at the watershed rather than site (segment) level of resolution. Further sampling for stressor identification and/or TMDL development will later define the extent of impairment.

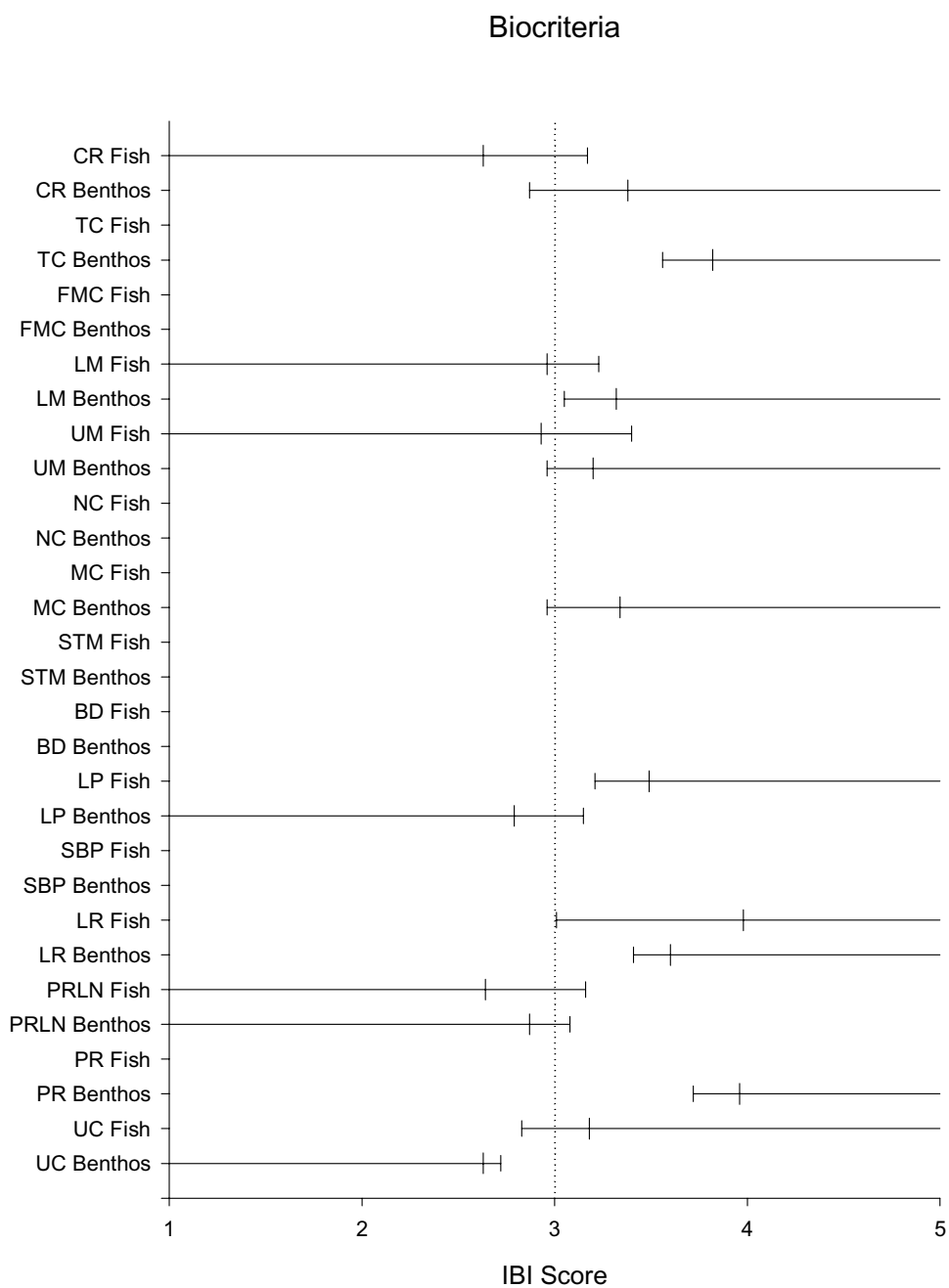


Figure 7-1. Mean fish and benthic IBI scores, with one-sided confidence intervals, for 8-digit watersheds

Abbreviations for watershed names			
CR	Casselman River	BD	Brighton Dam
TC	Town Creek	LP	Little Patuxent River
FMC	Fifteen Mile Creek	SBP	South Branch Patapsco
LM	Lower Monocacy River	LR	Liberty Reservoir
UM	Upper Monocacy River	PRLN	Patapsco River Lower North Branch
NC	Nanjemoy Creek	PR	Prettyboy Reservoir
MC	Mattawoman Creek	UC	Upper Choptank
STM	St. Mary's River		

Table 7-1. Provisional ratings of Maryland 8-digit watersheds sampled in the 2000 MBSS based on Maryland's interim biocriteria framework. "Pass" indicates results meet criteria; "fail" indicates results fail to meet criteria.

8 Digit Watershed	Indicator	Mean Indicator Value	Lower Confidence Limit	Upper Confidence Limit	Status	Overall Status
Brighton Dam	Benthos				Not Rated	Not Rated
	Fish				Not Rated	
Casselman River	Benthos	3.38	2.87		Inconclusive	Inconclusive
	Fish	2.63		3.17	Inconclusive	
Fifteen Mile Creek	Benthos				Not Rated	Not Rated
	Fish				Not Rated	
Liberty Reservoir	Benthos	3.60	3.41		Pass	Pass
	Fish	3.98	3.87	3.87	Pass	
Little Patuxent River	Benthos	2.79		3.15	Inconclusive	Inconclusive
	Fish	3.49	3.21		Pass	
Lower Monocacy River	Benthos	3.32	3.05		Pass	Inconclusive
	Fish	2.96		3.23	Inconclusive	
Mattawoman Creek	Benthos	3.34	2.96		Inconclusive	Inconclusive
	Fish				Not Rated	
Nanjemoy Creek	Benthos				Not Rated	Not Rated
	Fish				Not Rated	
Patapsco River Lower North Branch	Benthos	2.87		3.08	Inconclusive	Inconclusive
	Fish	2.64		3.16	Inconclusive	
Prettyboy Reservoir	Benthos	3.96	3.72		Pass	Pass
	Fish				Not Rated	
South Branch Patapsco	Benthos				Not Rated	Not Rated
	Fish				Not Rated	
St. Mary's River	Benthos				Not Rated	Not Rated
	Fish				Not Rated	
Town Creek	Benthos	3.82	3.56		Pass	Pass
	Fish				Not Rated	
Upper Choptank	Benthos	2.38		2.72	Fail	Fail
	Fish	3.18	2.83		Inconclusive	
Upper Monocacy River	Benthos	3.10	2.96		Inconclusive	Inconclusive
	Fish	2.93		3.40	Inconclusive	

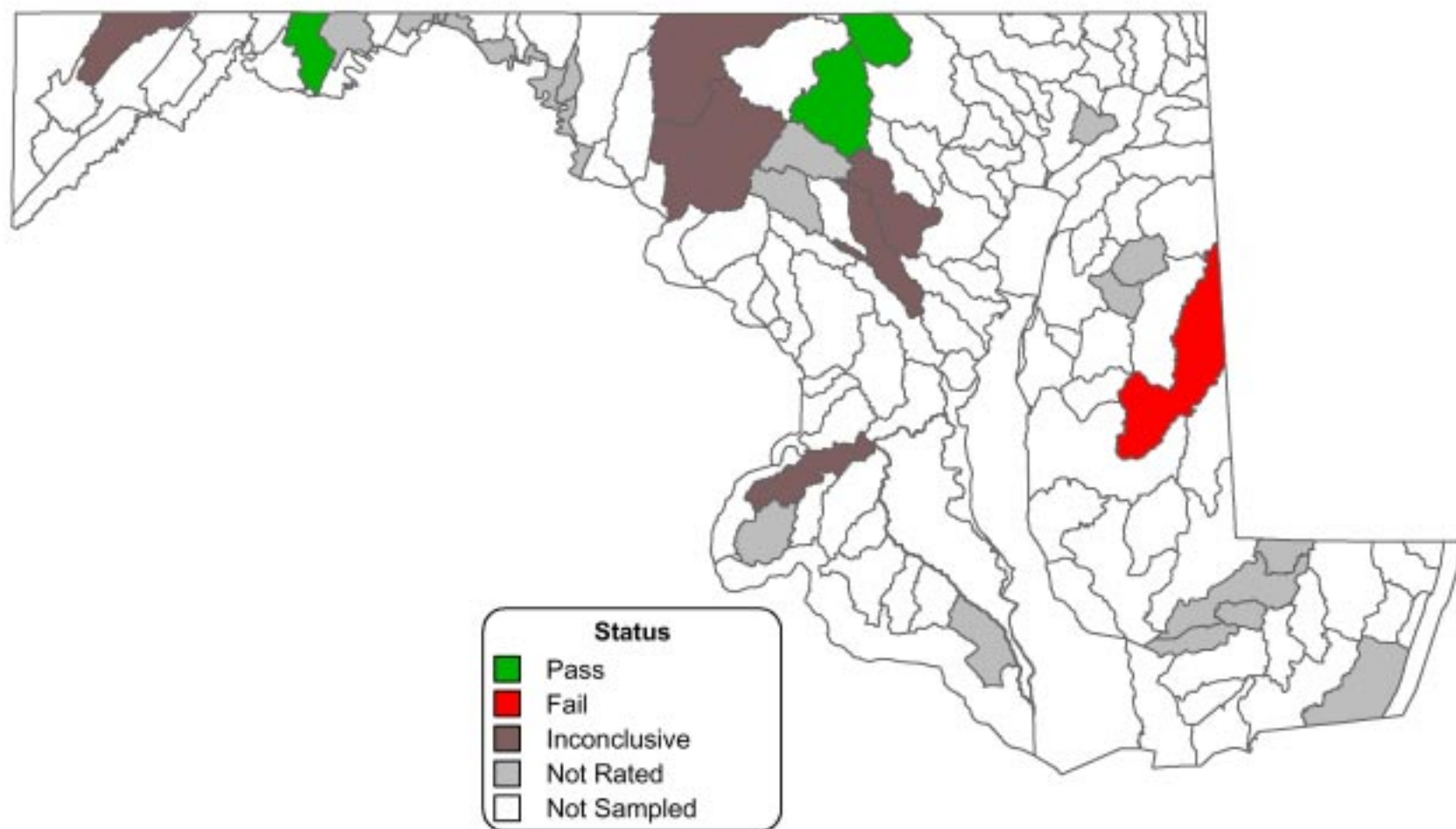


Figure 7-2. Results of applying interim biocriteria framework to assess 8-digit watersheds using MBSS 2000 data

Table 7-2. Provisional ratings of Maryland 12-digit subwatersheds sampled in the 2000 MBSS based on Maryland's interim biocriteria framework							
8 Digit Watershed	8 Digit Watershed Status	12 Digit Subwatershed	Number of Sites Pass	Number of Sites Inconclusive	Number of Sites Fail	Number of Sites Not Rated	12 Digit Status
Aberdeen Proving Ground	Not Rated	021307051124					Not Sampled
		021307051125				1	Not Rated
		021307051126	0	0	5	1	Fail
Swan Creek	Not Rated	021301061135	2	1	0	1	Inconclusive
		021301061136					Not Sampled
Brighton Dam	Not Rated	021311080966	2	1	0		Inconclusive
		021311080967	0	0	1		Fail
		021311080968					Not Sampled
		021311080969	4	1	0		Inconclusive
		021311080970	1	1	0		Inconclusive
		021311080971					Not Sampled
		021311080972					Not Sampled
		021311080973					Not Sampled
Casselman River	Inconclusive	050202040030	0	0	2		Fail
		050202040031					Not Sampled
		050202040032	1	0	0		Pass
		050202040033	1	0	1		Fail
		050202040034	1	0	2		Fail
		050202040035					Not Sampled
		050202040036					Not Sampled
		050202040037	1	0	0		Pass
		050202040038	0	0	1		Fail
Corsica River	Not Rated	021305070395				1	Not Rated
		021305070396	1	0	1		Fail
		021305070397	1		1		Fail
Southeast Creek	Not Rated	021305080398					Not Sampled
		021305080399	0	1	2		Fail
		021305080400					Not Sampled
		021305080401	0	1	0		Inconclusive
		021305080402					Not Sampled
		021305080403	1	0	0		Pass
		021305080404					Not Sampled

Table 7-2. (Continued)							
8 Digit Watershed	8 Digit Watershed Status	12 Digit Subwatershed	Number of Sites Pass	Number of Sites Inconclusive	Number of Sites Fail	Number of Sites Not Rated	12 Digit Status
Fifteen Mile Creek	Not Rated	021405110134					Not Sampled
		021405110135	3	0	0		Pass
		021405110136					Not Sampled
		021405110137	2	0	0		Pass
		021405110138	3	0	0		Pass
		021405110139					Not Sampled
		021405110140					Not Sampled
		021405110141					Not Sampled
		021405110142	1	0	0		Pass
		021405110143					Not Sampled
		021405110144					Not Sampled
		021405110145					Not Sampled
		021405110146					Not Sampled
		021405110147	1	0	0		Pass
Liberty Reservoir	Pass	021309071046					Not Sampled
		021309071047					Not Sampled
		021309071048	2	3	0		Inconclusive
		021309071049					Not Sampled
		021309071050	4	0	0		Pass
		021309071051					Not Sampled
		021309071052	1	0	0		Pass
		021309071053					Not Sampled
		021309071054					Not Sampled
		021309071055	1	0	0		Pass
		021309071056	2	1	0		Inconclusive
		021309071057					Not Sampled
		021309071058	1	1	0		Inconclusive
		021309071059					Not Sampled
		021309071060					Not Sampled
		021309071061					Not Sampled
		021309071062					Not Sampled

Table 7-2. (Continued)							
8 Digit Watershed	8 Digit Watershed Status	12 Digit Subwatershed	Number of Sites Pass	Number of Sites Inconclusive	Number of Sites Fail	Number of Sites Not Rated	12 Digit Status
Little Patuxent River	Inconclusive	021311050946	0	0	1		Fail
		021311050947	0	0	2		Fail
		021311050948	0	0	2		Fail
		021311050949					Not Sampled
		021311050950	0	2	0		Inconclusive
		021311050951					Not Sampled
		021311050952					Not Sampled
		021311050953					Not Sampled
		021311050954	0	1	1		Fail
		021311050955					Not Sampled
		021311050956					Not Sampled
		021311050957	1	2	1		Fail
Lower Monocacy River	Inconclusive	021403020222	1	0	0		Pass
		021403020223	0	1	0		Inconclusive
		021403020224	1	0	1		Fail
		021403020225					Not Sampled
		021403020226					Not Sampled
		021403020227	0	0	1		Fail
		021403020228	1	1	0		Inconclusive
		021403020229	1	0	0		Pass
		021403020230	0	0	1		Fail
		021403020231					Not Sampled
		021403020232					Not Sampled
		021403020233	0	0	2		Fail
		021403020234					Not Sampled
		021403020235	0	1	0		Inconclusive
		021403020236	0	0	1		Fail
		021403020237	0	2	2		Fail
		021403020238	2	0	0		Pass
		021403020239	0	1	1		Fail

Table 7-2. (Continued)							
8 Digit Watershed	8 Digit Watershed Status	12 Digit Subwatershed	Number of Sites Pass	Number of Sites Inconclusive	Number of Sites Fail	Number of Sites Not Rated	12 Digit Status
Lower Wicomico	Not Rated	021303010553					Not Sampled
		021303010554					Not Sampled
		021303010555					Not Sampled
		021303010556					Not Sampled
		021303010557					Not Sampled
		021303010558	1	0	1		Fail
		021303010559	0	0	0	1	Not Rated
		021303010560					Not Sampled
		021303010561					Not Sampled
		021303010562	0	0	1		Fail
Monie Bay	Not Rated	021303020544	0	0	0	1	Not Rated
Wicomico Creek	Not Rated	021303030563					Not Sampled
		021303030564					Not Sampled
		021303030565					Not Sampled
Wicomico River Head	Not Rated	021303040566	0	0	1		Fail
		021303040567	0	0	0	1	Not Rated
		021303040568	0	0	1	1	Fail
		021303040569	0	0	1		Fail
		021303040570					Not Sampled
Mattawoman Creek	Inconclusive	021401110780	1	1	0		Inconclusive
		021401110781	0	0	2	1	Fail
		021401110782					Not Sampled
		021401110783	0	0	1		Fail
		021401110784					Not Sampled
		021401110785	2	0	0		Pass
		021401110786	0	1	2		Fail
		021401110787					Not Sampled
		021401110788					Not Sampled
Nanjemoy Creek	Not Rated	021401100775	0	1	0		Inconclusive
		021401100776	0	0	2		Fail
		021401100777	1	0	3		Fail
		021401100778	1	0	0		Pass
		021401100779	1	1	0		Inconclusive

Table 7-2. (Continued)							
8 Digit Watershed	8 Digit Watershed Status	12 Digit Subwatershed	Number of Sites Pass	Number of Sites Inconclusive	Number of Sites Fail	Number of Sites Not Rated	12 Digit Status
Patapsco River Lower North Br	Inconclusive	021309061011	0	0	0	1	Not Rated
		021309061012	0	0	1		Fail
		021309061013					Not Sampled
		021309061014	0	2	1		Fail
		021309061015	1	1	1		Fail
		021309061016	0	0	1		Fail
		021309061017	0	1	2		Fail
		021309061018					Not Sampled
		021309061019	1	1	1		Fail
Potomac River Wa County	Not Rated	021405010155	0	0	1		Fail
		021405010156					Not Sampled
		021405010157					Not Sampled
		021405010158	0	0	1		Fail
		021405010159					Not Sampled
		021405010160	1	0	0		Pass
		021405010161					Not Sampled
		021405010162	0	0	1	1	Fail
		021405010163					Not Sampled
		021405010164					Not Sampled
		021405010165	0	0	1		Fail
		021405010166					Not Sampled
		021405010167					Not Sampled
Marsh Run	Not Rated	021405030185	0	0	2		Fail
		021405030186	0	1	0		Inconclusive
Tonoloway	Not Rated	021405070168					Not Sampled
Little Tonoloway	Not Rated	021405090153	0	0	1		Fail
		021405090154	0	2	1		Fail
Prettyboy Reservoir	Pass	021308060313	3	0	1		Fail
		021308060314	2	1	0		Inconclusive
		021308060315	1	0	0		Pass
		021308060316					Not Sampled
		021308060317	1	0	1		Fail

Table 7-2. (Continued)							
8 Digit Watershed	8 Digit Watershed Status	12 Digit Subwatershed	Number of Sites Pass	Number of Sites Inconclusive	Number of Sites Fail	Number of Sites Not Rated	12 Digit Status
South Branch Patapsco	Not Rated	021309081020	2	0	0		Pass
		021309081021					Not Sampled
		021309081022	2	1	0		Inconclusive
		021309081023					Not Sampled
		021309081024					Not Sampled
		021309081025	1	0	0		Pass
		021309081026	1	0	0		Pass
		021309081027					Not Sampled
		021309081028	1	0	0		Pass
		021309081029					Not Sampled
		021309081030	1	0	0		Pass
		021309081031	1	0	0		Pass
St. Mary's River	Not Rated	021401030709	0	0	1	1	Fail
		021401030710	1	0	0		Pass
		021401030711					Not Sampled
		021401030712	0	1	0		Inconclusive
		021401030713					Not Sampled
		021401030714	1	0	1		Fail
		021401030715					Not Sampled
		021401030716					Not Sampled
		021401030717	1	0	0		Pass
		021401030718	0	0	1		Fail
		021401030719	0	0	2		Fail

Table 7-2. (Continued)							
8 Digit Watershed	8 Digit Watershed Status	12 Digit Subwatershed	Number of Sites Pass	Number of Sites Inconclusive	Number of Sites Fail	Number of Sites Not Rated	12 Digit Status
Town Creek	Not Rated	021405120122	0	0	1		Fail
		021405120123	1	0	1		Fail
		021405120124	0	0	1		Fail
		021405120125					Not Sampled
		021405120126	1	0	0		Pass
		021405120127					Not Sampled
		021405120128	1	0	0		Pass
		021405120129	1	1	0		Inconclusive
		021405120130	1	0	0		Pass
		021405120131	1	0	0		Pass
		021405120132					Not Sampled
		021405120133					Not Sampled
Upper Choptank	Fail	021304040472	0	1	0		Inconclusive
		021304040473					Not Sampled
		021304040474					Not Sampled
		021304040475					Not Sampled
		021304040476					Not Sampled
		021304040477					Not Sampled
		021304040478					Not Sampled
		021304040479					Not Sampled
		021304040480					Not Sampled
		021304040481					Not Sampled
		021304040482					Not Sampled
		021304040483	0	0	1		Fail
		021304040484					Not Sampled
		021304040485	0	0	1		Fail
		021304040486	0	0	1		Fail
		021304040487	1	0	1		Fail
		021304040488					Not Sampled
		021304040489					Not Sampled
		021304040490					Not Sampled
		021304040491					Not Sampled
		021304040492	0	0	0	1	Not Rated

Table 7-2. (Continued)							
8 Digit Watershed	8 Digit Watershed Status	12 Digit Subwatershed	Number of Sites Pass	Number of Sites Inconclusive	Number of Sites Fail	Number of Sites Not Rated	12 Digit Status
Upper Choptank (Continued)		021304040493					Not Sampled
		021304040494	1	0	0		Pass
		021304040495					Not Sampled
		021304040496					Not Sampled
		021304040497					Not Sampled
		021304040498					Not Sampled
		021304040499					Not Sampled
		021304040500					Not Sampled
		021304040501					Not Sampled
		021304040502					Not Sampled
		021304040503					Not Sampled
		021304040504					Not Sampled
		021304040505	0	1	1		Fail
		021304040506					Not Sampled
		021304040507					Not Sampled
		021304040508	0	0	1		Fail
		021304040509	0	0	1		Fail
		021304040510					Not Sampled
		021304040511					Not Sampled
		021304040512					Not Sampled
		021304040513					Not Sampled
		021304040514	0	0	1		Fail
		021304040515	0	0	1		Fail

Table 7-2. (Continued)							
8 Digit Watershed	8 Digit Watershed Status	12 Digit Subwatershed	Number of Sites Pass	Number of Sites Inconclusive	Number of Sites Fail	Number of Sites Not Rated	12 Digit Status
Upper Monocacy River	Inconclusive	021403030240					Not Sampled
		021403030241					Not Sampled
		021403030242	0	0	1		Fail
		021403030243	0	0	1		Fail
		021403030244	2	1	1		Fail
		021403030245	0	0	1		Fail
		021403030246					Not Sampled
		021403030247	0	1	0		Inconclusive
		021403030249					Not Sampled
		021403030250					Not Sampled
		021403030251	3	1	1	1	Fail
		021403030252					Not Sampled
		021403030253					Not Sampled
		021403030254					Not Sampled
		021403030255					Not Sampled
		021403030256					Not Sampled
		021403030257	0	0	1		Fail
		021403030258	1	0	0		Pass
		021403030259	0	1	1		Fail
		021403030260					Not Sampled
		021403030261					Not Sampled
		021403030262					Not Sampled
		021403030263					Not Sampled
		021403030264					Not Sampled
		021403030265					Not Sampled
		021403030266					Not Sampled
		021403030267					Not Sampled

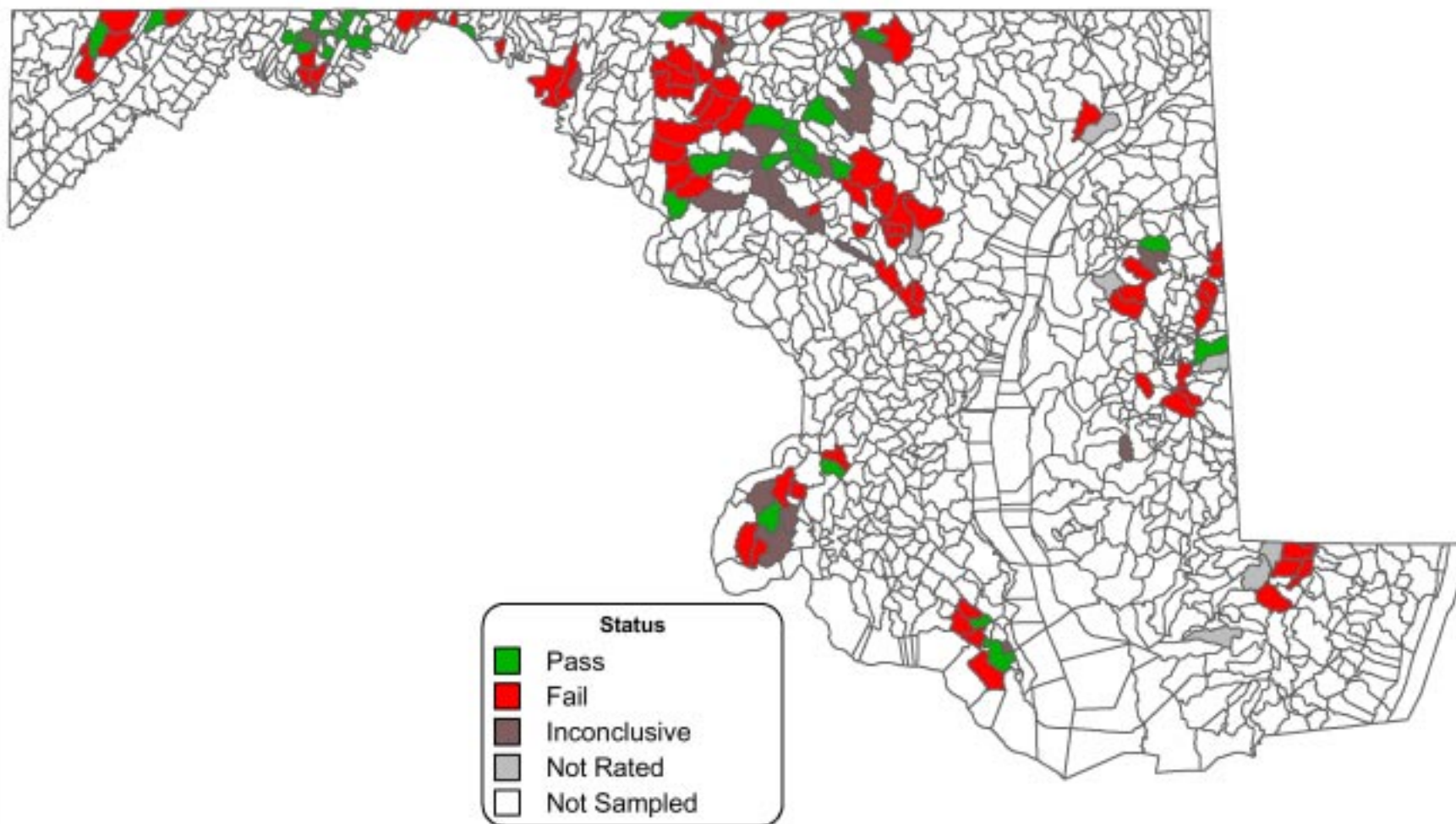


Figure 7-3. Results of applying interim biocriteria to assess 12-digit subwatersheds using MBSS 2000 data

Table 7-3. Summary of 12-digit subwatersheds status ratings, including the number falling within each type of 8-digit watershed					
12-digit Subwatershed Status	Number of 12-digit Subwatersheds that are within Failing 8-digit Watersheds	Number of 12-digit Subwatersheds that are within Passing 8-digit Watersheds	Number of 12-digit Subwatersheds that are within Inconclusive 8-digit Watersheds	Number of 12-digit Subwatersheds that are within Unrated 8-digit Watersheds	Total Number of 12-digit Subwatersheds
Fail	9	2	32	26	69
Pass	1	4	7	20	32
Inconclusive	1	4	6	11	22
Not Rated	1	0	1	5	7
Total Sampled					130
Not Sampled					134
Total					264

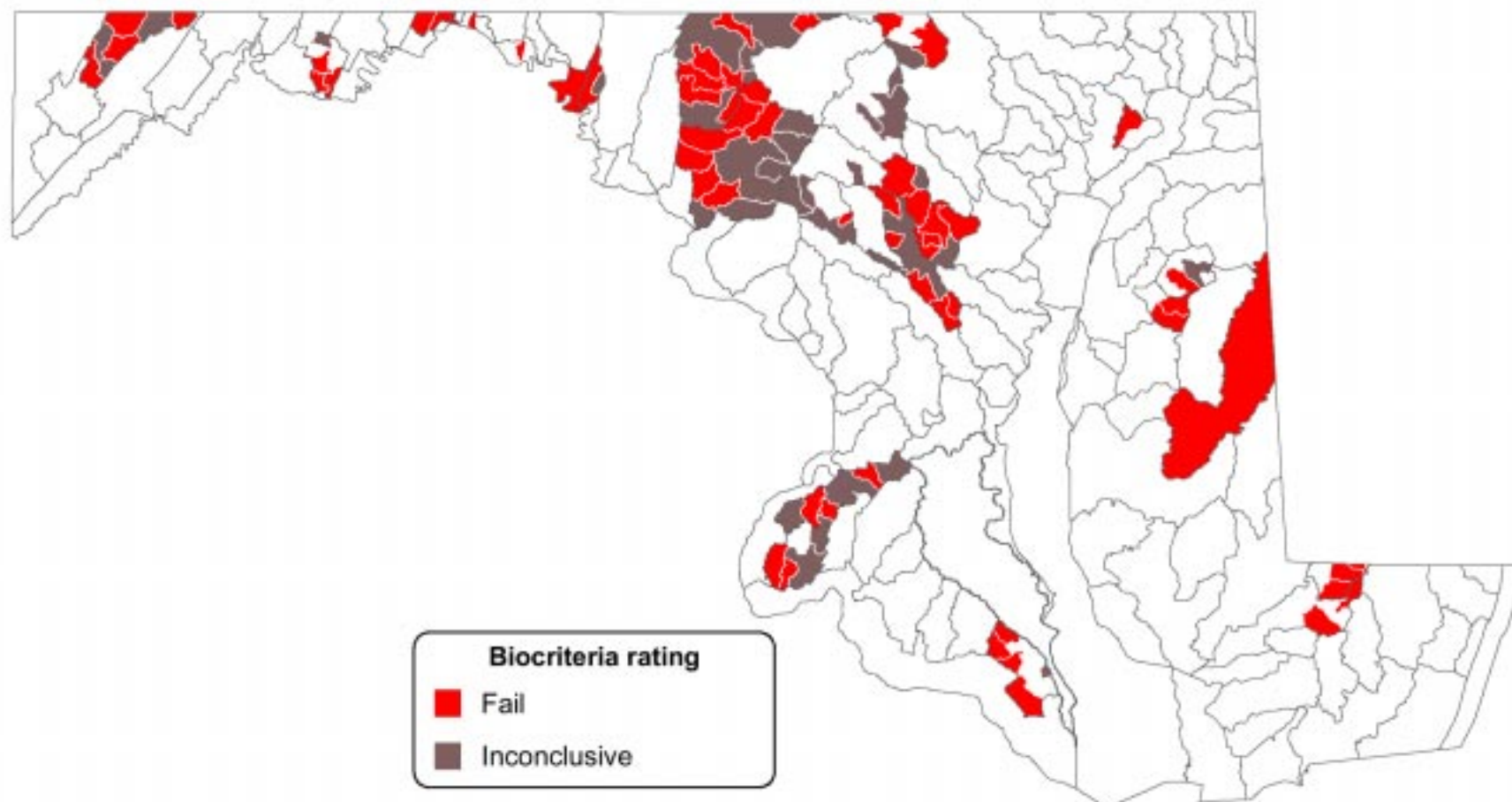


Figure 7-4. Combined set of 8-digit and 12-digit watersheds designated as failing or inconclusive, when interim biocriteria framework was applied to MBSS 2000 data.

The range of possible extent can also be estimated from MBSS data, because the simple random sampling design does support estimation (with known confidence) of the extent of streams having a particular characteristic of interest. For example, we can estimate the percentage of stream miles in a subwatershed that would fail to meet biocriteria, and we can know the exact confidence interval around that estimate, even with small sample sizes. Figure 7-5 illustrates examples of the exact 90% confidence intervals for small samples, for varying numbers of sites sampled ($n = 1$ to 10), given that all samples have the same outcome. Figure 7-6 shows examples of exact 90% confidence intervals for small samples, given that an outcome occurs in 50% of the samples (e.g., 1 out of 2, 4 out of 8). These confidence intervals are not only applicable to stream

data, but are in fact based on the binomial distribution, which would apply to any case with two possible outcomes such as pass/fail.

To evaluate the extent of stream miles failing, 90% confidence intervals were estimated for “percentage of stream miles that fail” in each of the 12-digit watersheds flagged as failing (Table 7-4). Because of the large number of 12-digit subwatersheds that fail to meet criteria, this information could be used to help establish priorities for where managers should target effort in developing remediation strategies. The MDE Biological Criteria Advisory Committee is in the process of examining this and other related recommendations.

Table 7-4. Estimated percentage of stream miles failing, with upper and lower 90% confidence limits (CL), for Maryland 12 digit subwatersheds that rate as “failing” under interim biocriteria framework					
8 Digit Watershed	8 Digit Watershed Status	12 Digit Subwatershed	Percentage of Stream Miles that Fail	Lower 90% CL	Upper 90% CL
Aberdeen Proving Ground	Not Rated	021307051126	83.33	41.82	99.15
Brighton Dam	Not Rated	021311080967	100	5	100
Casselman River	Inconclusive	050202040030	100	22.36	100
		050202040033	50	2.53	97.47
		050202040034	66.67	13.54	98.3
		050202040038	100	5	100
Corisca River	Not Rated	021305070396	50	2.53	97.47
		021305070397	50	2.53	97.47
Southeast Creek	Not Rated	021305080399	66.67	13.54	98.3
Little Patuxent River	Inconclusive	021311050946	100	5	100
		021311050947	100	22.36	100
		021311050948	100	22.36	100
		021311050954	50	2.53	97.47
		021311050957	50	9.76	90.24
Lower Monocacy River	Inconclusive	021403020224	50	2.53	97.47
		021403020227	100	5	100
		021403020230	100	5	100
		021403020233	100	22.36	100
		021403020236	100	5	100
		021403020237	50	9.76	90.24
		021403020239	50	2.53	97.47
Lower Wicomico River	Not Rated	021303010558	50	2.53	97.47
		021303010562	100	5	100
Wicomico River Head	Not Rated	021303040566	100	5	100
		021303040568	50	2.53	97.47
		021303040569	100	5	100
Mattawoman Creek	Inconclusive	021401110781	66.67	13.54	98.3
		021401110783	100	5	100
		021401110786	66.67	13.54	98.3
Nanjemoy Creek	Not Rated	021401100776	100	22.53	100
		021401100777	75	24.59	98.73

Table 7-4. (Continued)					
8 Digit Watershed	8 Digit Watershed Status	12 Digit Subwatershed	Percentage of Stream Miles that Fail	Lower 90% CL	Upper 90% CL
Patapasco River Lower North Br	Inconclusive	021309061012	100	5	100
		021309061014	33.33	1.7	86.46
		021309061015	33.33	1.7	86.46
		021309061016	100	5	100
		021309061017	66.67	13.54	98.3
		021309061019	33.33	1.7	86.46
Potomac River Wa County	Not Rated	021405010155	100	5	100
		021405010158	100	5	100
		021405010162	50	2.53	97.47
		021405010165	100	5	100
Marsh Run	Not Rated	021405030185	100	22.36	100
Little Tonoloway	Not Rated	021405090153	100	5	100
		021405090154	33.33	1.7	86.46
Prettyboy Reservoir	Pass	021308060313	25	1.27	75.14
		021308060317	50	2.53	97.47
St. Mary's River	Not Rated	021401030709	50	2.53	97.47
		021401030714	50	2.53	97.47
		021401030718	100	5	100
		021401030719	100	22.36	100
Town Creek	Not Rated	021405120122	100	5	100
		021405120123	50	2.53	97.47
		021405120124	100	5	100
Upper Choptank	Fail	021304040483	100	5	100
		021304040485	100	5	100
		021304040486	100	5	100
		021304040487	50	2.53	97.47
		021304040505	50	2.53	97.47
		021304040508	100	5	100
		021304040509	100	5	100
		021304040514	100	5	100
		021304040515	100	5	100

Table 7-4. (Continued)					
8 Digit Watershed	8 Digit Watershed Status	12 Digit Subwatershed	Percentage of Stream Miles that Fail	Lower 90% CL	Upper 90% CL
Upper Monocacy River	Inconclusive	021403030242	100	5	100
		021403030243	100	5	100
		021403030244	25	1.27	75.14
		021403030245	100	5	100
		021403030251	16.67	8.5	58.18
		021403030257	100	5	100
		021403030259	50	2.53	97.47

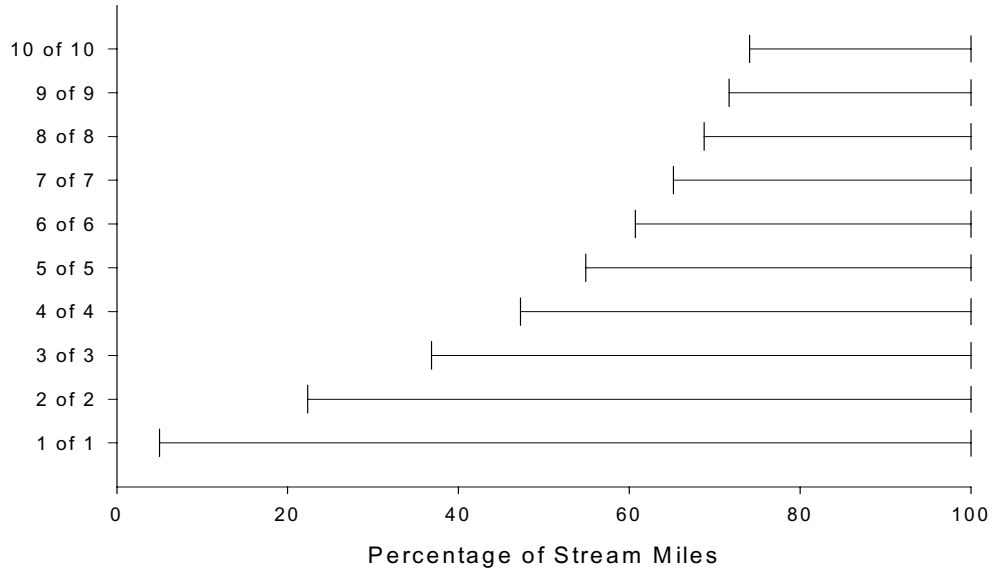


Figure 7-5. Examples of two-sided 90% confidence intervals for the percentage of stream miles with a given characteristic of interest. Numbers on y-axis represent the number of samples with the characteristic, out of a total number of simple random samples.

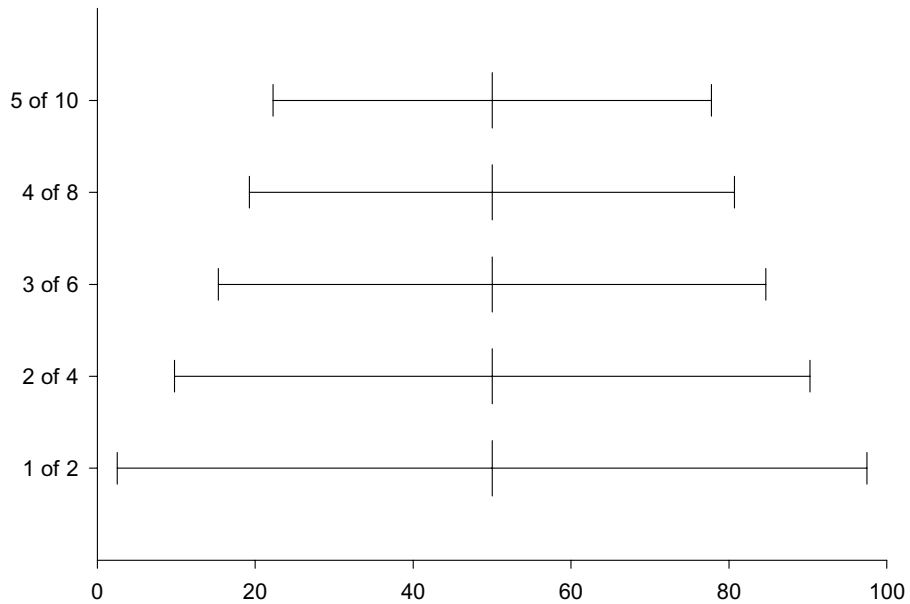


Figure 7-6. Examples of two-sided 90% confidence intervals for the percentage of stream miles with a given characteristic of interest. Numbers on y-axis represent the number of samples with the characteristic, out of a total number of simple random samples.

8 MANAGEMENT IMPLICATIONS AND FUTURE DIRECTIONS

The goal of the Maryland Biological Stream Survey (MBSS or Survey) is to provide natural resource managers, policymakers, and the public with the information they need to make effective natural resource decisions about the State's non-tidal streams and the watersheds they drain. For this reason, the Survey was designed to answer a set of 64 management questions. In the Round One report (Roth et al. 1999), many of these questions were answered, while some remained unanswered and new questions were raised. Many of the answers were the first scientifically defensible and management-relevant answers obtained for these questions.

By the end of Round One, it was apparent that certain management concerns had changed and programmatic needs were evolving. The changes instituted in Round Two were designed to address this changing management context. This chapter focuses on the management implications of the results obtained in 2000, recognizing that this sampling year is only one of five and that many questions will only be answered after Round Two is completed. In addition to implications of the core survey results, this chapter discusses the future sampling and monitoring/assessment activities planned for Round Two and beyond.

8.1 MANAGEMENT IMPLICATIONS

Information from Round One of the Survey is being heavily used to support management and policy initiatives at DNR. Results from sampling in 2000 and future years will be used to help refine answers to the MBSS questions and to address new issues that arise. In addition to serving DNR's program needs, a number of other agencies and institutions have an interest in the Survey's answers to its primary objectives:

- assess the current status of biological resources in Maryland's non-tidal streams;
- quantify the extent to which acidic deposition has affected or may be affecting biological resources in the state;
- examine which other water chemistry, physical habitat, and land use factors are important in explaining the current status of biological resources in streams;
- provide a statewide inventory of stream biota;

- establish a benchmark for long-term monitoring of trends in these biological resources; and
- target future local-scale assessments and mitigation measures needed to restore degraded biological resources.

The information being obtained by the Survey is expected to be highly useful for the new stream corridor goals of the Chesapeake Bay Program. The Chesapeake 2000 Agreement (signed by Virginia, Maryland, Pennsylvania, District of Columbia, U.S. EPA, and Chesapeake Bay Commission) newly recognizes "the need to focus on the individuality of each river, stream and creek" to meet the goal—"Preserve, protect and restore those habitats and natural areas that are vital to the survival and diversity of the living resources of the Bay and its rivers." Specifically, the Agreement commits to the following watershed-based actions:

- Develop and implement watershed management plans in two-thirds of the Bay watershed
- Develop guidelines to ensure the aquatic health of stream corridors
- Select pilot projects that promote stream corridor protection and restoration
- Make available information concerning the aquatic health of stream corridors
- Develop stream corridor restoration goals based on local watershed management planning

Results from the 2000 sampling, as well as future years, will be used to support these actions, just as Round One results were provided to the State's Tributary Strategies program to address the nutrient reduction goals.

The stream corridor information provided by the Survey will also prove invaluable for statewide programs such as the riparian buffer restoration and Greenprint initiatives. As part of the Chesapeake Bay wide goal of restoring 2,010 miles of riparian buffers in the Chesapeake Bay watershed by the year 2010, Maryland has committed to restoring 600 miles of riparian vegetation along its stream corridors. MBSS ground verification of remotely sensed riparian areas can be used, along with data on ecological stream condition,

to determine where restoration will provide the greatest restoration benefit. In a separate initiative, Maryland has designated substantial funding to purchase Greenprint lands that will contribute to an interconnected green infrastructure across the state. Stream corridors are an important part of the contiguous forest and wetland habitats that make up the green infrastructure (linked hubs and corridors worthy of preservation or restoration). MBSS data on the condition of constituent streams will help assign priorities for the purchase of Greenprint lands.

The results of Round Two will continue to support Maryland's participation in the federal Clean Water Action Plan. Round One MBSS data were an essential component of the first Unified Watershed Assessment prepared under this Plan; specifically, DNR incorporated mean values by Maryland 8-digit watersheds for both the fish IBI and benthic IBI. These indicators provided some of the best information provided to U.S. EPA by any state. These IBIs were used with other indicators to help designate both Category 1 (priorities for restoration) and Category 3 (priorities for protection) watersheds within Maryland. Restoration strategies have been developed for many of these priority watersheds, and 2000 sampling results will be used to help implement them (e.g., in Little Patuxent River watershed). Because the design of Round Two focuses on the finer geographic scale of Maryland 8-digit watersheds, future Unified Watershed Assessments will be more complete. Characterization at the 12-digit Maryland watershed scale will be possible for many areas using core MBSS results augmented by county and volunteer monitoring.

In addition to supporting these targeting initiatives, the identification of degraded stream segments has implications for comprehensive protection under the Clean Water Act. Section 101 of the Act states that physical, chemical, and biological integrity of waters should be maintained. Stream segments that fail to do this can be designated as degraded and not attaining designated uses as part of their water quality standards. The Maryland Department of the Environment (MDE) implements the water quality standards program and prepares a 303(d) list of streams not meeting their designated uses. U.S. EPA is encouraging Maryland and other states to use biological criteria (biocriteria) to meet negotiated agreements for expanding their 303(d) lists. Streams rated as poor or very poor by MBSS data are candidates for inclusion on the 303(d) list. Ultimately, total maximum daily loads (TMDLs) must be developed for streams on this list.

Using Round One MBSS data, MDE developed an interim biocriteria framework for Maryland that incorporates stream ratings based on fish and benthic IBIs developed by the

Survey (Roth et al. 2000, Stribling et al. 1998) to identify 8-digit watersheds and 12-digit subwatersheds that are impaired. Results from MBSS 2000 will be incorporated with other data to prepare the State's Clean Water Act 303(d) list and biennial 305(b) water quality report. The result of our initial application of the interim biocriteria framework to the MBSS 2000 data indicate that one of the 19 8-digit watersheds sampled and a number of 12-digit subwatersheds are candidates for the 303(d) list (see Chapter 7).

Another important use of MBSS biological data for the water quality standards program is refinement of aquatic life use designations. Each water body in Maryland has an associated designated use that (along with appropriate physical, chemical, and biological criteria) make up the water quality standard for that water body. While some streams have a special use, such as a reproducing trout stream, most have the same general aquatic life use. This general use designation does not capture the natural variability of Maryland streams and therefore does not extend any special protection to streams with unusual diversity or ecological value. U.S. EPA is encouraging states to refine their aquatic life uses into categories with more precise biocriteria. Data from the Survey will be critical to refining aquatic life use designations in this way.

The information on biological diversity collected by the MBSS exceeds that needed to designate the ecological condition of individual watersheds. The extensive geographic reach and quantitative sampling results of the Survey provide an unusual opportunity for evaluating the distribution and abundance of species previously designated as rare only by anecdotal evidence. In 2000 alone, the endemic checkered sculpin and several other species were collected in previously unreported locations. Based on the information gathered in Round One, Maryland DNR's Heritage and Biodiversity Programs are reevaluating state designations of rare, threatened, and endangered species. These reevaluations, as well as MBSS data on unique combinations of species at the ecosystem and landscape levels, will provide critical new information to support biodiversity conservation in the state.

8.2 FUTURE DIRECTIONS

At the end of Round One, it was discovered that most of the original 64 MBSS questions that could not yet be answered dealt with identifying potential stressors using data not collected as part of the Survey. Much of this information will be gathered from other sources and linked to MBSS sites so that statewide estimates can be made of stressor

extent (e.g., number of stream miles with point sources of contamination, amounts of pesticides applied by geographic area, or pattern of landscape patches in upstream catchments). The other issues of original and new interest dealt in large part with the need for finer geographic resolution. As described above, the Round Two design (including adoption of the new 1:100,000-scale stream network, focus on Maryland 8-digit watersheds, and volunteer monitoring at the 12-digit subwatershed scale) will begin to provide this improved resolution. Issues that require continued scrutiny in future years include the following:

- Extending the Survey into tidal streams
- Delineating more stream types requiring new indicators (e.g., coldwater and blackwater streams)
- Refining existing indicators (e.g., physical habitat) and developing new ones (e.g., streamside salamanders in small streams)
- Better characterization of existing and new stressors (e.g., estimating the contribution of eroded soil to sediment loading)
- Improving identification of rare species habitats and other biodiversity components
- Comparing among sample rounds for the detection of trends
- More coordination with counties for greater sample density or cost savings in areas of shared interest

Round Two is capturing considerably more small streams and a few more larger streams than in Round One. This increased efforts provides nearly comprehensive coverage of the stream resources in Maryland. The principal remaining gap is tidal streams, those not covered by tidewater monitoring at DNR. The Round Two design includes a component dedicated to tidal stream sampling that has not yet been implemented because of lack of funding. Specifically, the Round Two design includes pilot sampling of tidal streams that follows the lattice design used for non-tidal streams and includes the same subset of 84 watersheds for sampling each year. A random sample of 20 sites would be selected within each watershed containing tidal streams, and the number of sites allocated to each watershed would be proportional to their tidal stream length.

Analysis of Round One data revealed that Maryland contains substantial miles of streams that are ecologically distinct in terms of natural fish communities. Three kinds of streams were identified where the existing fish IBI is not an effective indicator of stream condition: (1) small streams draining catchments of less than 300 acres, (2) coldwater streams characterized by lower temperatures and prevalence

of trout species, and (3) blackwater streams characterized by low pH and high organic content. Temperature loggers were deployed at nearly all randomly selected stream sites in 2000 (and will continue to be deployed throughout Round Two) to improve our ability to identify coldwater streams. Round Two also includes ancillary sampling of coldwater and blackwater streams (which occur in too low proportions of total streams to be captured adequately by the core survey) that will be used to support development of appropriate fish IBIs for these streams. In 2000, 15 coldwater sites were sampled in both stressed and healthy coldwater streams; additional sampling of blackwater streams is planned for future years. The Survey is cooperating with the U.S. Geological Survey to study the feasibility of using streamside salamander sampling in small MBSS streams to develop a second vertebrate indicator for this stream type.

In Round One, a provisional indicator of physical habitat quality, the Physical Habitat Index (PHI), was developed from the quantitative and qualitative data collected in 1995-1997. The approach focused on including only those parameters that were significantly correlated with biological characteristics of interest. The Survey will revisit its approach for assessing stream physical habitat quality in 2001 by reanalyzing all existing physical habitat data.

Effective characterization of stressors will continue to be an important part of the Survey. In many cases, accurate diagnosis of site-specific problems is beyond the capabilities of the Survey and follow-up monitoring is required. This will be the case in most watersheds highlighted for possible inclusion on the state's 303d list of impaired waters. Only when specific causes of degradation are identified and quantified can TMDLs be developed. Nonetheless, the Survey will continue to investigate new analyses of stressor data and produce estimates of the extent and severity of problems to help in natural resource management decision making. In 2000, new information was gathered on riparian buffer, exotic plants, channelization, bar formation, and bank erosion. The total area of eroding banks was reported as an indicator of the amount of sediment being contributed downstream by each watershed. In future years, statistics on these and other stressors will be developed.

As Round Two continues to sample new streams throughout the state, we expect that new location records for many species will be reported. As these records accumulate, the Survey will make them available to the Maryland DNR Heritage and Biodiversity Programs for future listing reevaluations and management planning. The Survey will also conduct more analysis on unique combinations of

species at the ecosystem and landscape levels. Specifically, biodiversity maps based on Round One MBSS data and rare, threatened, and endangered species data will be augmented with Round Two data and GAP analysis data developed by the Heritage and Biodiversity Programs and U.S. Fish and Wildlife Service.

At present, little work has been done to prepare species-specific management plans for unique or at-risk aquatic species. Because the Survey collects information that can be used to identify stressors within a watershed, MBSS data can serve as a logical starting point for developing restoration and protection strategies. Given that the Survey has produced abundance estimates for rare and unique fishes, prioritization of management plan development can be based on population size and known threats.

One of the most important benefits of collecting Round Two data will be the ability of the Survey to compare results over time and detect trends in natural variability, environmental degradation, and restoration success. The sampling in 2000 provides the first opportunity to compare stream condition in selected watersheds across the two rounds. Future sampling years will provide more opportunities and, once Round Two is completed in 2004, rigorous statewide estimates with ample sample density will be used to investigate trends. The interpretation of trends requires that natural temporal change be characterized and understood. To this end, Round Two will continue to annually monitor 25 sentinel sites selected and sampled in 2000. These sites represent the best stream conditions in the state and focus on those areas least likely to change

through anthropogenic impact (e.g., in state-managed or protected areas). As Round Two progresses, data from annual sampling of sentinel sites will be analyzed for natural temporal variability.

Recognizing that the core and ancillary sampling by Maryland DNR will never be able to attain the sample density needed for all management decisions in the state, the Survey is focusing on coordination with other monitoring programs (usually county governments) during Round Two. During 2000, comparability analyses were conducted with the biological sampling program of Montgomery County with funding from U.S. EPA. Differences in sample frame, survey design, sampling methods, indicator construction, and reporting were investigated and procedures for combining the results of the two programs were developed. A methods comparison study for benthic sampling and analysis is planned for future years. The Survey is also considering developing guidance for counties in benthic taxonomy, as well as data base standards for sharing of information. To the extent possible, sampling results (e.g., fish IBIs) will be integrated into combined estimates for public reporting in 2000. The Survey will continue coordination with Montgomery, Prince George's, Howard, Carroll, Baltimore and other counties plus Baltimore City, in future years to ensure that programs obtain either greater sample densities or cost savings (from sharing sample sites) for monitoring Maryland streams. The Maryland Water Monitoring Council (MWMC) will play an active role in encouraging these collaborations between state and local agencies.

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APPENDIX A

PRECIPITATION DATA

Table A-1. Total monthly precipitation (inches) and deviation from normal for Maryland regions in 1998														
Region	January-98	Deviation	February-98	Deviation	March-98	Deviation	April-98	Deviation	May-98	Deviation	June-98	Deviation	July-98	Deviation
Southern Eastern Shore	8.04	4.40	6.98	3.55	4.65	0.53	3.12	-0.05	4.46	1.00	5.15	1.76	1.52	-2.53
Central Eastern Shore	7.41	3.83	6.34	3.08	5.33	1.59	3.19	0.44	3.39	-0.56	5.10	1.45	1.40	-2.54
Lower Southern	6.69	3.41	7.00	3.96	6.35	2.66	3.51	0.32	4.29	0.21	6.95	3.23	1.02	-2.94
Upper Southern	5.77	2.72	5.94	3.00	6.37	2.96	3.75	0.43	4.74	0.52	4.01	0.31	1.69	-2.32
Northern Eastern Shore	5.65	2.38	4.30	0.98	6.03	2.48	3.65	0.37	4.92	0.91	4.92	0.93	3.42	-0.38
Northern Central	6.00	2.92	4.93	1.96	6.34	2.81	3.94	0.41	5.51	1.14	4.67	0.69	3.17	-0.63
Appalachian Mountain	4.50	1.89	5.29	2.74	3.32	0.01	4.76	1.32	3.91	-0.02	4.44	0.99	2.76	-0.78
Allegheny Plateau	4.74	1.56	4.38	1.43	3.44	-0.52	5.54	1.47	5.01	0.64	6.54	2.46	3.29	-1.57
Average for State	6.10	2.89	5.65	2.59	5.23	1.57	3.93	0.59	4.53	0.48	5.22	1.48	2.28	-1.71

Table A-1. (Continued)												
Region	August-98	Deviation	September-98	Deviation	October-98	Deviation	November-98	Deviation	December-98	Deviation	Annual	Deviation
Southern Eastern Shore	2.75	-2.12	1.53	-1.88	1.01	-2.17	1.10	-2.02	3.67	0.26	43.98	0.73
Central Eastern Shore	3.02	-1.38	1.34	-2.17	2.58	-0.49	1.02	-2.30	4.20	0.64	44.92	1.59
Lower Southern	1.55	-2.42	0.50	-3.17	1.28	-1.96	1.17	-2.22	2.50	-0.83	42.81	0.25
Upper Southern	1.31	-2.86	1.79	-1.79	0.92	-2.39	1.27	-2.16	1.79	-1.58	39.32	-3.16
Northern Eastern Shore	3.03	-0.85	2.86	-0.79	1.36	-1.78	0.90	-2.49	1.87	-1.82	42.63	-0.06
Northern Central	2.57	-1.28	1.82	-1.89	2.82	-0.52	1.10	-2.48	1.19	-2.28	44.06	0.85
Appalachian Mountain	2.29	-1.05	1.74	-1.46	1.33	-1.84	0.25	-2.86	0.85	-1.97	35.44	-3.03
Allegheny Plateau	3.74	-0.09	3.26	-0.06	1.49	-1.68	0.48	-3.08	1.30	-2.38	43.21	-1.82
Average for State	2.53	-1.51	1.86	-1.65	1.60	-1.60	0.91	-2.45	2.17	-1.25	42.05	-0.58

Table A-2. Total monthly precipitation (inches) and deviation from normal for Maryland regions in 1999

Region	January-99	Deviation	February-99	Deviation	March-99	Deviation	April-99	Deviation	May-99	Deviation	June-99	Deviation	July-98	Deviation
Southern Eastern Shore	8.04	4.40	6.98	3.55	4.65	0.53	3.12	-0.05	4.46	1.00	5.15	1.76	1.52	-2.53
Central Eastern Shore	7.41	3.83	6.34	3.08	5.33	1.59	3.19	0.44	3.39	-0.56	5.10	1.45	1.40	-2.54
Lower Southern	6.69	3.41	7.00	3.96	6.35	2.66	3.51	0.32	4.29	0.21	6.95	3.23	1.02	-2.94
Upper Southern	5.77	2.72	5.94	3.00	6.37	2.96	3.75	0.43	4.74	0.52	4.01	0.31	1.69	-2.32
Northern Eastern Shore	5.65	2.38	4.30	0.98	6.03	2.48	3.65	0.37	4.92	0.91	4.92	0.93	3.42	-0.38
Northern Central	6.00	2.92	4.93	1.96	6.34	2.81	3.94	0.41	5.51	1.14	4.67	0.69	3.17	-0.63
Appalachian Mountain	4.50	1.89	5.29	2.74	3.32	0.01	4.76	1.32	3.91	-0.02	4.44	0.99	2.76	-0.78
Allegany Plateau	4.74	1.56	4.38	1.43	3.44	-0.52	5.54	1.47	5.01	0.64	6.54	2.46	3.29	-1.57
Average for State	6.10	2.89	5.65	2.59	5.23	1.57	3.93	0.59	4.53	0.48	5.22	1.48	2.28	-1.71

Table A-2. (Continued)

Region	August-99	Deviation	September-99	Deviation	October-99	Deviation	November-99	Deviation	December-99	Deviation	Annual	Deviation
Southern Eastern Shore	2.75	-2.12	1.53	-1.88	1.01	-2.17	1.10	-2.02	3.67	0.26	43.98	0.73
Central Eastern Shore	3.02	-1.38	1.34	-2.17	2.58	-0.49	1.02	-2.30	4.20	0.64	44.92	1.59
Lower Southern	1.55	-2.42	0.50	-3.17	1.28	-1.96	1.17	-2.22	2.50	-0.83	42.81	0.25
Upper Southern	1.31	-2.86	1.79	-1.79	0.92	-2.39	1.27	-2.16	1.79	-1.58	39.32	-3.16
Northern Eastern Shore	3.03	-0.85	2.86	-0.79	1.36	-1.78	0.90	-2.49	1.87	-1.82	42.63	-0.06
Northern Central	2.57	-1.28	1.82	-1.89	2.82	-0.52	1.10	-2.48	1.19	-2.28	44.06	0.85
Appalachian Mountain	2.29	-1.05	1.74	-1.46	1.33	-1.84	0.25	-2.86	0.85	-1.97	35.44	-3.03
Allegany Plateau	3.74	-0.09	3.26	-0.06	1.49	-1.68	0.48	-3.08	1.30	-2.38	43.21	-1.82
Average for State	2.53	-1.51	1.86	-1.65	1.60	-1.60	0.91	-2.45	2.17	-1.25	42.05	-0.58

Table A-3. Total monthly precipitation (inches) and deviation from normal for Maryland Regions in 2000												
Region	January-00	Deviation	February-00	Deviation	March-00	Deviation	April-00	Deviation	May-00	Deviation	June-00	Deviation
Southern Eastern Shore	4.14	0.50	2.30	-1.13	6.20	2.08	4.39	1.22	2.52	-0.94	6.32	2.93
Central Eastern Shore	4.17	0.59	1.73	-1.57	6.03	2.29	4.05	0.70	2.67	-1.28	4.76	1.11
Lower Southern	NA	NA	1.56	-1.48	4.64	0.95	4.25	1.06	2.98	-1.10	4.08	0.36
Upper Southern	3.49	0.44	2.17	-0.77	4.42	1.01	4.77	1.45	2.93	-1.29	4.98	1.28
Northern Eastern Shore	3.56	0.29	2.32	-0.72	6.20	2.65	4.88	1.60	3.14	-0.87	4.47	0.48
Northern Central	3.20	0.12	2.44	-0.53	4.75	1.22	4.42	0.89	3.48	-0.89	4.11	0.13
Appalachian Mountain	1.55	-1.06	2.89	0.34	2.51	-0.80	3.61	0.17	3.89	-0.04	3.54	0.09
Allegheny Plateau	1.88	-1.30	4.32	1.37	2.81	-1.15	2.88	-1.19	4.32	-0.05	5.01	0.93
Average for State	3.14	-0.06	2.47	-0.56	4.70	1.03	4.16	0.74	3.24	-0.81	4.66	0.91

Table A-3. (Continued)												
Region	July-00	Deviation	August-00	Deviation	September-00	Deviation	October-00	Deviation	November-00	Deviation	December-00	Deviation
Southern Eastern Shore	5.86	1.81	3.97	-0.90	4.44	1.03	0.03	-3.12	1.82	-1.30	1.97	-1.44
Central Eastern Shore	9.25	5.31	4.02	-0.38	3.98	0.47	0.08	-2.99	2.81	-0.51	2.28	-1.28
Lower Southern	9.44	5.48	5.35	1.38	5.32	1.65	0.03	-3.21	2.62	-0.77	4.58	1.25
Upper Southern	6.43	2.42	4.14	-0.03	5.69	2.11	0.14	-3.17	1.83	-1.57	2.91	-0.46
Northern Eastern Shore	6.79	2.99	4.17	0.29	5.67	2.02	0.48	-2.66	2.11	-1.28	3.32	-0.37
Northern Central	5.33	1.53	4.06	0.21	5.81	2.10	0.37	-2.97	1.98	-1.60	2.97	-0.50
Appalachian Mountain	4.10	0.56	4.67	1.33	6.32	3.12	0.62	-2.55	1.99	-1.12	2.14	-0.68
Allegheny Plateau	4.77	-0.09	3.66	-0.17	4.95	1.63	0.90	-2.27	2.21	-1.35	1.78	-1.90
Average for State	6.50	2.50	4.26	0.22	5.27	1.77	0.33	-2.87	2.17	-1.19	2.74	-0.67

APPENDIX B

PARAMETER ESTIMATES BY PSU

Table B-1. Fish IBI					
PSU	Mean	Median	Std Dev	Min	Max
Casselman River	2.63	2.57	1.34	1.00	4.43
Town Creek	2.55	1.57	1.67	1.00	5.00
Fifteen Mile Creek	3.00	3.29	1.68	1.00	4.71
PR Wa Co	2.12	2.43	0.94	1.00	3.29
Upper Monocacy	2.92	3.57	1.25	1.00	4.43
Mattawoman Cr	2.94	2.88	1.00	1.75	4.25
Nanjemoy Creek	2.63	3.00	1.16	1.00	3.75
St Mary's River	2.93	3.25	1.31	1.00	4.75
Brighton Dam	3.54	3.67	0.53	2.56	4.33
Little Patuxent	3.37	3.22	0.67	2.33	4.33
S Br Patapsco	3.63	3.67	0.57	2.56	4.33
Liberty Res	3.98	4.11	0.33	3.00	4.33
Patapsco L N Br	2.64	2.78	1.26	1.22	4.56
Prettyboy Res	3.62	3.89	1.14	1.44	5.00
ABPG/Swan Creek	2.37	2.78	1.19	1.00	3.67
Cors R/SE Cr	3.78	3.75	0.71	2.75	4.75
Upper Choptank	3.18	3.38	0.84	1.50	4.00
Lower Wico	2.94	2.75	0.97	2.00	4.25

Table B-2. Fish IBI			
PSU	Percentage of Stream Miles with FIBI < 3	Lower 90% CI	Upper 90% CI
Casselman River	60.0	30.4	85.0
Town Creek	57.1	22.5	87.5
Fifteen M Creek	42.9	12.9	77.5
PR Wa CO	63.6	35.0	84.5
Upper Monocacy	38.5	16.6	64.5
Mattawoman Cr	50.0	19.3	80.7
Nanjemoy Creek	50.0	15.3	84.7
St Mary's River	42.9	12.9	77.5
Brighton Dam	11.1	0.6	42.9
Little Patuxent	25.0	7.2	52.7
S Br Patapsco	12.5	0.6	47.1
Liberty Res	0.0	0.0	19.3
Patapsco L N Br	50.0	22.2	77.8
Prettyboy Res	22.2	4.1	55.0
ABPG/Swan Creek	57.1	22.5	87.5
Cors R/SE Cr	12.5	0.6	47.1
Upper Choptank	30.0	8.7	60.7
Lower Wico	50.0	9.8	90.2

Table B-3. Benthic IBI					
	Mean	Median	Std Dev	Min	Max
Casselman River	3.38	3.67	1.27	1.22	4.78
Town Creek	3.82	3.78	0.65	2.56	4.78
Fifteen Mile Creek	3.82	4.00	0.59	2.56	4.78
PR Wa Co	2.79	2.78	0.51	1.89	3.44
Upper Monocacy	3.10	3.11	0.85	1.44	4.33
Mattawoman Cr	3.26	3.29	0.93	1.86	4.71
Nanjemoy Creek	2.60	2.86	1.02	1.00	3.86
St Mary's River	2.77	2.57	1.16	1.00	4.43
Brighton Dam	3.69	3.89	0.85	2.11	4.78
Little Patuxent	2.79	2.78	1.03	1.29	4.33
S Br Patapsco	3.71	3.67	0.72	2.33	4.78
Liberty Res	3.60	3.44	0.57	2.78	4.56
Patapsco L N Br	2.84	2.78	0.60	1.89	3.67
Prettyboy Res	3.96	4.11	0.57	2.78	4.56
ABPG/Swan Creek	2.14	1.86	1.08	1.29	4.11
Cors R/SE Cr	3.23	3.14	1.04	1.57	4.71
Upper Choptank	2.63	2.43	0.99	1.29	4.43
Lower Wico	1.60	1.43	0.64	1.00	3.00

Table B-4. Benthic IBI			
PSU	Percentage of Stream Miles with BIBI < 3	Lower 90% CI	Upper 90% CI
Casselman River	30.0	8.7	60.7
Town Creek	10.0	0.5	39.4
Fifteen M Creek	10.0	0.5	39.4
PR Wa CO	53.9	28.7	77.6
Upper Monocacy	38.9	19.9	60.8
Mattawoman Cr	36.4	13.5	65.0
Nanjemoy Creek	50.0	22.2	77.8
St Mary's River	60.0	30.4	85.0
Brighton Dam	18.2	3.3	47.0
Little Patuxent	53.9	28.7	77.6
S Br Patapsco	9.1	0.5	36.4
Liberty Res	18.8	5.3	41.7
Patapsco L N Br	53.3	30.0	75.6
Prettyboy Res	10.0	0.5	39.4
ABPG/Swan Creek	81.8	53.0	96.7
Cors R/SE Cr	40.0	15.0	69.7
Upper Choptank	57.1	32.5	79.4
Lower Wico	90.0	60.6	99.5

Table B-5. Combined Biotic Index					
	Mean	Median	Std Dev	Min	Max
Casselman River	3.00	2.87	1.20	1.11	4.35
Town Creek	3.29	3.06	0.88	2.40	4.67
Fifteen Mile Creek	3.52	3.54	0.58	2.70	4.41
PR Wa Co	2.52	2.49	0.61	1.44	3.44
Upper Monocacy	2.97	3.30	0.94	1.44	4.27
Mattawoman Cr	3.06	2.79	0.85	2.14	4.48
Nanjemoy Creek	2.60	3.00	1.06	1.00	3.86
St Mary's River	2.78	2.59	1.18	1.00	4.59
Brighton Dam	3.70	3.67	0.52	3.00	4.56
Little Patuxent	3.08	3.22	0.51	2.11	3.67
S Br Patapsco	3.67	3.50	0.53	3.00	4.56
Liberty Res	3.72	3.78	0.46	2.78	4.33
Patapsco L N Br	2.78	2.89	0.71	1.56	3.89
Prettyboy Res	3.82	4.06	0.57	2.56	4.44
ABPG/Swan Creek	2.14	1.86	0.99	1.14	3.89
Cors R/SE Cr	3.37	3.27	0.87	1.57	4.46
Upper Choptank	2.82	2.96	0.87	1.68	4.43
Lower Wico	1.79	1.82	0.82	1.00	3.63

Table B-6. Combined Biotic Index			
PSU	Percentage of Stream Miles with CBI < 3	Lower 90% CI	Upper 90% CI
Casselman River	60.0	30.4	85.0
Town Creek	50.0	22.2	77.8
Fifteen M Creek	30.0	8.7	60.7
PR Wa CO	69.2	42.7	88.7
Upper Monocacy	44.4	24.4	65.9
Mattawoman Cr	54.6	27.1	80.0
Nanjemoy Creek	50.0	22.2	77.8
St Mary's River	60.0	30.4	85.0
Brighton Dam	0.0	0.0	23.8
Little Patuxent	38.5	16.6	64.5
S Br Patapsco	0.0	0.0	23.8
Liberty Res	12.5	2.3	34.4
Patapsco L N Br	53.3	30.0	75.6
Prettyboy Res	10.0	5.1	39.4
ABPG/Swan Creek	81.8	53.0	96.7
Cors R/SE Cr	20.0	3.7	50.7
Upper Choptank	57.1	32.5	79.4
Lower Wico	90.0	60.6	99.5

Table B-7. Spring pH < 6			
PSU	Percentage of Stream Miles with Spring pH < 6	Lower 90% CI	Upper 90% CI
Casselman River	40.0	15.0	69.7
Town Creek	0.0	0.0	25.9
Fifteen M Creek	0.0	0.0	25.9
PR Wa CO	7.7	0.4	31.6
Upper Monocacy	16.7	4.7	37.7
Mattawoman Cr	27.3	7.9	56.4
Nanjemoy Creek	70.0	39.3	91.3
St Mary's River	36.4	13.5	65.0
Brighton Dam	0.0	0.0	23.8
Little Patuxent	0.0	0.0	20.6
S Br Patapsco	0.0	0.0	23.8
Liberty Res	0.0	0.0	17.1
Patapsco L N Br	6.7	0.3	27.9
Prettyboy Res	0.0	0.0	25.9
ABPG/Swan Creek	9.1	0.5	36.4
Cors R/SE Cr	0.0	0.0	25.9
Upper Choptank	21.4	6.1	46.6
Lower Wico	50.0	22.2	77.8

Table B-8. Summer pH < 6			
PSU	Percentage of Stream Miles with Summer pH < 6	Lower 90% CI	Upper 90% CI
Casselman River	20.0	3.7	50.7
Town Creek	0.0	0.0	31.2
Fifteen M Creek	0.0	0.0	31.2
PR Wa CO	0.0	0.0	22.1
Upper Monocacy	0.0	0.0	16.2
Mattawoman Cr	0.0	0.0	25.9
Nanjemoy Creek	40.0	15.0	69.7
St Mary's River	11.1	0.6	42.9
Brighton Dam	0.0	0.0	23.8
Little Patuxent	0.0	0.0	20.6
S Br Patapsco	0.0	0.0	23.8
Liberty Res	0.0	0.0	17.1
Patapsco L N Br	7.7	0.4	31.6
Prettyboy Res	0.0	0.0	25.9
ABPG/Swan Creek	0.0	0.0	28.3
Cors R/SE Cr	0.0	0.0	25.9
Upper Choptank	28.6	10.4	54.0
Lower Wico	50.0	22.2	77.8

Table B-9. ANC < 50			
PSU	Percentage of Stream Miles with ANC < 50 $\mu\text{eq/l}$	Lower 90% CI	Upper 90% CI
Casselman River	40.0	15.0	69.7
Town Creek	0.0	0.0	25.9
Fifteen M Creek	0.0	0.0	25.9
PR Wa CO	7.7	0.4	31.6
Upper Monocacy	16.7	4.7	37.7
Mattawoman Cr	18.2	3.3	47.0
Nanjemoy Creek	70.0	39.3	91.3
St Mary's River	36.4	13.5	65.0
Brighton Dam	0.0	0.0	23.8
Little Patuxent	0.0	0.0	20.6
S Br Patapsco	0.0	0.0	23.8
Liberty Res	0.0	0.0	17.1
Patapsco L N Br	6.7	0.3	27.9
Prettyboy Res	0.0	0.0	23.8
ABPG/Swan Creek	0.0	0.0	23.8
Cors R/SE Cr	0.0	0.0	23.8
Upper Choptank	0.0	0.0	19.3
Lower Wico	40.0	15.0	69.7

Table B-10. ANC < 200			
PSU	Percentage of Stream Miles with ANC < 200 $\mu\text{eq/l}$	Lower 90% CI	Upper 90% CI
Casselman River	70.0	39.3	91.3
Town Creek	50.0	22.2	77.8
Fifteen M Creek	80.0	49.3	96.3
PR Wa CO	15.4	2.8	41.0
Upper Monocacy	16.7	4.7	37.7
Mattawoman Cr	63.6	35.0	86.5
Nanjemoy Creek	100.0	74.1	0.0
St Mary's River	72.7	43.6	92.1
Brighton Dam	0.0	0.0	23.8
Little Patuxent	0.0	0.0	20.6
S Br Patapsco	9.1	0.5	36.4
Liberty Res	0.0	0.0	17.1
Patapsco L N Br	6.7	0.3	27.9
Prettyboy Res	0.0	0.0	25.9
ABPG/Swan Creek	18.2	3.3	47.0
Cors R/SE Cr	10.0	0.5	39.4
Upper Choptank	42.9	20.6	67.5
Lower Wico	60.0	30.4	85.0

Table B-11. PHI					
PSU	Mean	Median	Std Dev	Min	Max
Casselman River	59.02	59.55	25.24	21.14	99.83
Town Creek	36.48	9.30	40.89	3.22	88.91
Fifteen Mile Creek	42.67	41.42	29.50	2.20	79.66
PR Wa Co	61.36	54.43	32.06	9.65	99.78
Upper Monocacy	50.30	38.32	35.51	4.24	97.77
Mattawoman Cr	79.19	89.77	26.37	26.57	97.07
Nanjemoy Creek	62.18	73.86	33.05	5.22	94.35
St Mary's River	75.52	90.69	30.41	1.92	94.29
Brighton Dam	81.56	89.69	20.86	37.81	99.86
Little Patuxent	79.65	86.39	25.00	14.09	99.89
S Br Patapsco	64.37	69.58	26.20	25.53	97.94
Liberty Res	78.61	82.88	19.12	34.60	99.79
Patapsco L N Br	69.28	60.92	22.04	25.92	95.69
Prettyboy Res	73.74	77.14	25.79	32.23	99.23
ABPG/Swan Creek	30.34	30.15	28.22	2.80	91.59
Cors R/SE Cr	48.85	53.90	24.11	2.00	85.71
Upper Choptank	49.63	49.36	28.29	3.65	90.31
Lower Wico	38.68	30.81	26.66	12.31	79.79

Table B-12. PHI < 42			
PSU	Percentage of Stream Miles with PHI < 42	Lower 90% CI	Upper 90% CI
Casselman River	20.0	3.7	50.7
Town Creek	62.5	28.9	88.9
Fifteen M Creek	50.0	19.3	80.7
PR Wa CO	33.3	12.3	60.9
Upper Monocacy	56.3	33.3	77.3
Mattawoman Cr	20.0	3.7	50.7
Nanjemoy Creek	20.0	3.7	50.7
St Mary's River	11.1	0.6	42.9
Brighton Dam	9.1	0.5	36.4
Little Patuxent	7.7	0.4	31.6
S Br Patapsco	27.3	7.9	56.4
Liberty Res	6.3	0.3	26.4
Patapsco L N Br	7.7	0.4	31.6
Prettyboy Res	10.0	0.5	39.4
ABPG/Swan Creek	77.8	45.0	95.9
Cors R/SE Cr	30.0	8.7	60.7
Upper Choptank	30.8	11.3	57.3
Lower Wico	60.0	30.4	85.0

Table B-13. Channelized			
PSU	Percentage of Stream Miles Channelized	Lower 90% CI	Upper 90% CI
Casselman River	10.0	0.5	39.4
Town Creek	10.0	0.5	39.4
Fifteen M Creek	0.0	0.0	25.9
PR Wa CO	6.3	0.3	26.4
Upper Monocacy	14.3	0.4	32.9
Mattawoman Cr	0.0	0.0	23.8
Nanjemoy Creek	9.1	0.5	36.4
St Mary's River	0.0	0.0	23.8
Brighton Dam	0.0	0.0	23.8
Little Patuxent	14.3	2.6	38.5
S Br Patapsco	8.3	0.4	33.9
Liberty Res	12.5	2.3	34.4
Patapsco L N Br	37.5	17.8	60.9
Prettyboy Res	20.0	3.7	50.7
ABPG/Swan Creek	50.0	24.5	75.5
Cors R/SE Cr	10.0	0.5	39.4
Upper Choptank	50.0	26.4	73.6
Lower Wico	45.5	20.0	72.9

Table B-14. Moderate to Severe Bank Erosion			
PSU	Percentage of Stream Miles with Moderate to Severe Bank Erosion	Lower 90% CI	Upper 90% CI
Casselman River	40.0	15.0	69.7
Town Creek	62.5	28.9	88.9
Fifteen M Creek	12.5	0.6	47.1
PR Wa CO	58.3	31.5	81.9
Upper Monocacy	11.8	2.1	32.6
Mattawoman Cr	20.0	3.7	50.7
Nanjemoy Creek	60.0	30.4	85.0
St Mary's River	44.4	16.9	74.9
Brighton Dam	90.9	63.6	99.5
Little Patuxent	92.3	68.4	99.6
S Br Patapsco	63.6	35.0	86.5
Liberty Res	75.0	51.6	91.0
Patapsco L N Br	61.5	35.5	83.4
Prettyboy Res	80.0	49.3	96.3
ABPG/Swan Creek	33.3	9.8	65.5
Cors R/SE Cr	40.0	15.0	69.7
Upper Choptank	46.2	22.4	71.3
Lower Wico	10.0	5.1	39.4

Table B-15. Moderate to Extensive Bar Formation			
PSU	Percentage of Stream Miles with Moderate to Extensive Bar Formation	Lower 90% CI	Upper 90% CI
Casselman River	85.7	47.9	99.3
Town Creek	50.0	15.3	84.7
Fifteen M Creek	37.5	11.1	71.1
PR Wa CO	36.4	13.5	65.0
Upper Monocacy	30.8	11.3	57.3
Mattawoman Cr	62.5	28.9	88.9
Nanjemoy Creek	83.3	41.8	99.2
St Mary's River	85.7	47.9	99.3
Brighton Dam	80.0	49.3	96.3
Little Patuxent	84.6	59.0	97.2
S Br Patapsco	40.0	15.0	69.6
Liberty Res	64.3	39.0	84.7
Patapsco L N Br	84.6	59.0	97.2
Prettyboy Res	37.5	11.1	71.1
ABPG/Swan Creek	60.0	18.9	92.4
Cors R/SE Cr	42.9	12.9	77.5
Upper Choptank	50.0	19.3	80.7
Lower Wico	0.0	0.0	19.3

Table B-16. 0 m Riparian Buffer on at Least One Bank			
PSU	Percentage of Stream Miles with 0 m Riparian Buffer on at Least One Bank	Lower 90% CI	Upper 90% CI
Casselman River	20.0	3.7	50.7
Town Creek	30.0	8.7	60.7
Fifteen M Creek	10.0	0.5	39.4
PR Wa CO	7.7	0.4	31.6
Upper Monocacy	16.7	4.7	37.7
Mattawoman Cr	0.0	0.0	23.8
Nanjemoy Creek	0.0	0.0	25.9
St Mary's River	0.0	0.0	23.8
Brighton Dam	0.0	0.0	23.8
Little Patuxent	0.0	0.0	20.6
S Br Patapsco	9.1	0.5	36.4
Liberty Res	6.3	0.3	26.4
Patapsco L N Br	6.7	0.3	27.9
Prettyboy Res	20.0	3.7	50.7
ABPG/Swan Creek	10.0	0.5	39.4
Cors R/SE Cr	0.0	0.0	25.9
Upper Choptank	7.1	0.4	29.7
Lower Wico	10.0	0.5	39.4

Table B-17. 0 m Riparian Buffer on Both Banks			
PSU	Percentage of Stream Miles with 0 m Riparian Buffer on Both Banks	Lower 90% CI	Upper 90% CI
Casselman River	20.0	3.7	50.7
Town Creek	10.0	0.5	39.4
Fifteen M Creek	10.0	0.5	39.4
PR Wa CO	7.7	0.4	31.6
Upper Monocacy	16.7	4.7	37.7
Mattawoman Cr	0.0	0.0	23.8
Nanjemoy Creek	0.0	0.0	25.9
St Mary's River	0.0	0.0	23.8
Brighton Dam	0.0	0.0	23.8
Little Patuxent	0.0	0.0	20.6
S Br Patapsco	9.1	0.5	36.4
Liberty Res	6.3	0.3	26.4
Patapsco L N Br	0.0	0.0	18.1
Prettyboy Res	20.0	3.7	50.7
ABPG/Swan Creek	0.0	0.0	25.9
Cors R/SE Cr	0.0	0.0	25.9
Upper Choptank	7.1	0.4	29.7
Lower Wico	10.0	0.5	39.4

Table B-18. Exotic Plants Present or Extensive			
PSU	Percentage of Stream Miles with Exotic Plants Present or Extensive	Lower 90% CI	Upper 90% CI
Casselman River	20.0	3.7	50.7
Town Creek	62.5	28.9	88.9
Fifteen M Creek	25.0	4.6	60.0
PR Wa CO	41.7	18.1	68.5
Upper Monocacy	76.5	54.0	91.5
Mattawoman Cr	60.0	30.4	85.0
Nanjemoy Creek	30.0	8.7	60.7
St Mary's River	33.3	9.8	65.5
Brighton Dam	100.0	76.2	100.0
Little Patuxent	92.3	68.4	99.6
S Br Patapsco	100.0	76.2	100.0
Liberty Res	100.0	82.9	100.0
Patapsco L N Br	100.0	79.4	100.0
Prettyboy Res	100.0	74.1	100.0
ABPG/Swan Creek	100.0	71.7	100.0
Cors R/SE Cr	90.0	60.6	99.5
Upper Choptank	76.9	50.5	93.4
Lower Wico	80.0	49.3	96.3

Table B-19. Total Instream Woody Debris + Rootwads					
PSU	Mean	Median	Std Dev	Min	Max
Casselman River	5.8	2.5	6.5	1.0	22.0
Town Creek	2.0	0.5	2.9	0.0	8.0
Fifteen Mile Creek	2.1	1.0	2.7	0.0	7.0
PR Wa Co	7.2	5.0	6.9	0.0	25.0
Upper Monocacy	3.9	3.0	4.0	0.0	14.0
Mattawoman Cr	12.4	10.0	8.4	6.0	34.0
Nanjemoy Creek	8.8	9.0	7.0	0.0	24.0
St Mary's River	8.5	7.5	7.8	0.0	22.0
Brighton Dam	7.4	6.0	4.9	1.0	18.0
Little Patuxent	21.5	11.0	35.0	4.0	135.0
S Br Patapsco	4.0	4.0	2.7	0.0	9.0
Liberty Res	6.6	4.5	5.1	0.0	16.0
Patapsco L N Br	6.2	6.5	4.3	0.0	13.0
Prettyboy Res	6.4	5.5	4.2	2.0	14.0
ABPG/Swan Creek	3.0	2.0	3.1	0.0	8.0
Cors R/SE Cr	11.5	10.5	5.9	2.0	25.0
Upper Choptank	5.7	6.0	3.8	0.0	13.0
Lower Wico	88.8	38.0	96.5	1.0	320.0

Table B-20. Instream Woody Debris					
PSU	Mean	Median	Std Dev	Min	Max
Casselman River	4.80	2.00	6.81	0.00	22.00
Town Creek	0.75	0.00	1.49	0.00	4.00
Fifteen Mile Creek	0.50	0.00	1.07	0.00	3.00
PR Wa Co	4.83	3.50	4.49	0.00	15.00
Upper Monocacy	1.76	1.00	1.64	0.00	5.00
Mattawoman Cr	8.00	6.00	8.59	2.00	31.00
Nanjemoy Creek	6.20	5.00	6.61	0.00	23.00
St Mary's River	5.67	3.00	6.98	0.00	19.00
Brighton Dam	5.73	5.00	3.95	0.00	14.00
Little Patuxent	16.15	6.00	31.63	2.00	120.00
S Br Patapsco	3.50	4.00	2.46	0.00	8.00
Liberty Res	4.44	3.00	4.15	0.00	14.00
Patapsco L N Br	4.08	4.00	2.53	0.00	8.00
Prettyboy Res	5.70	5.50	3.65	1.00	12.00
ABPG/Swan Creek	2.67	3.00	2.83	0.00	8.00
Cors R/SE Cr	9.10	7.50	6.31	1.00	24.00
Upper Choptank	3.75	3.00	3.65	0.00	13.00
Lower Wico	44.45	6.00	64.01	0.00	170.00

Table B-21. Dewatered Woody Debris					
PSU	Mean	Median	Std Dev	Min	Max
Casselman River	4.3	1.0	6.1	0.0	18.0
Town Creek	5.2	5.0	4.6	0.0	13.0
Fifteen Mile Creek	6.8	5.5	5.3	0.0	15.0
PR Wa Co	8.2	8.0	4.6	0.0	15.0
Upper Monocacy	4.9	3.0	5.5	0.0	23.0
Mattawoman Cr	5.5	5.0	4.0	0.0	12.0
Nanjemoy Creek	2.3	2.5	1.6	0.0	5.0
St Mary's River	3.8	3.0	3.9	0.0	13.0
Brighton Dam	9.1	11.0	4.5	0.0	14.0
Little Patuxent	13.0	6.0	17.7	2.0	65.0
S Br Patapsco	4.2	4.0	2.8	0.0	10.0
Liberty Res	4.1	3.0	3.5	0.0	13.0
Patapsco L N Br	7.9	7.0	6.8	1.0	26.0
Prettyboy Res	5.9	3.0	7.7	1.0	27.0
ABPG/Swan Creek	4.6	3.0	4.1	0.0	11.0
Cors R/SE Cr	8.0	5.5	5.7	3.0	21.0
Upper Choptank	4.9	4.0	4.8	0.0	15.0
Lower Wico	40.3	5.0	86.5	0.0	280.0

Table B-22. Total Woody Debris					
PSU	Mean	Median	Std Dev	Min	Max
Casselman River	9.1	10.0	7.3	1.0	22.0
Town Creek	5.3	5.0	4.6	0.0	13.0
Fifteen Mile Creek	5.8	4.5	6.1	0.0	18.0
PR Wa Co	12.0	13.0	6.9	0.0	21.0
Upper Monocacy	6.3	5.5	6.0	0.0	25.0
Mattawoman Cr	13.5	9.0	11.5	4.0	43.0
Nanjemoy Creek	8.5	6.5	6.3	0.0	23.0
St Mary's River	8.5	5.5	10.3	0.0	29.0
Brighton Dam	14.8	16.0	6.5	0.0	22.0
Little Patuxent	29.2	11.0	48.3	4.0	185.0
S Br Patapsco	7.7	7.5	3.3	1.0	13.0
Liberty Res	8.5	6.5	6.3	1.0	21.0
Patapsco L N Br	11.1	10.0	8.4	0.0	30.0
Prettyboy Res	11.6	9.0	8.2	4.0	30.0
ABPG/Swan Creek	7.2	6.0	6.1	0.0	17.0
Cors R/SE Cr	17.1	14.5	9.5	4.0	32.0
Upper Choptank	7.8	5.5	7.1	0.0	24.0
Lower Wico	81.1	38.0	96.9	1.0	280.0

Table B-23. Instream Rootwads					
PSU	Mean	Median	Std Dev	Min	Max
Casselman River	1.1	1.0	1.6	0.0	5.0
Town Creek	1.3	0.5	1.6	0.0	4.0
Fifteen Mile Creek	1.4	0.0	2.5	0.0	7.0
PR Wa Co	3.3	4.0	3.0	0.0	10.0
Upper Monocacy	2.4	2.0	2.7	0.0	9.0
Mattawoman Cr	4.4	4.5	2.4	0.0	8.0
Nanjemoy Creek	2.6	2.5	2.2	0.0	7.0
St Mary's River	3.8	4.0	2.2	0.0	7.0
Brighton Dam	1.6	1.0	1.3	0.0	4.0
Little Patuxent	5.4	4.0	5.2	1.0	18.0
S Br Patapsco	0.5	0.0	0.7	0.0	2.0
Liberty Res	2.1	2.0	2.1	0.0	7.0
Patapsco L N Br	2.6	2.0	2.6	0.0	9.0
Prettyboy Res	0.7	0.0	1.0	0.0	2.0
ABPG/Swan Creek	0.7	0.0	1.0	0.0	3.0
Cors R/SE Cr	2.4	1.5	2.2	0.0	7.0
Upper Choptank	2.7	3.0	2.8	0.0	7.0
Lower Wico	48.8	12.0	63.9	0.0	150.0

Table B-24. Dewatered Rootwads					
PSU	Mean	Median	Std Dev	Min	Max
Casselman River	7.2	7.5	4.9	0.0	14.0
Town Creek	6.0	6.0	5.0	0.0	12.0
Fifteen Mile Creek	6.8	7.5	4.5	0.0	13.0
PR Wa Co	7.9	6.5	7.1	0.0	27.0
Upper Monocacy	4.5	4.0	3.3	0.0	10.0
Mattawoman Cr	6.5	6.0	3.0	3.0	13.0
Nanjemoy Creek	5.0	4.5	2.9	2.0	11.0
St Mary's River	6.6	6.0	4.7	1.0	15.0
Brighton Dam	4.6	5.0	1.5	2.0	7.0
Little Patuxent	10.6	9.0	6.7	3.0	27.0
S Br Patapsco	2.6	1.0	2.5	1.0	8.0
Liberty Res	3.6	2.5	4.0	0.0	14.0
Patapsco L N Br	5.6	6.0	2.9	1.0	10.0
Prettyboy Res	2.1	2.0	1.9	0.0	6.0
ABPG/Swan Creek	2.4	1.0	4.5	0.0	14.0
Cors R/SE Cr	5.1	5.0	3.0	1.0	10.0
Upper Choptank	4.2	3.0	4.1	0.0	15.0
Lower Wico	5.9	0.0	9.9	0.0	28.0

Table B-25. Total Rootwads					
	Mean	Median	Std Dev	Min	Max
Casselman River	8.2	9.0	5.5	0.0	15.0
Town Creek	7.3	6.5	6.4	0.0	15.0
Fifteen Mile Creek	6.5	7.5	5.2	0.0	13.0
PR Wa Co	10.1	10.0	8.1	0.0	31.0
Upper Monocacy	6.6	7.0	5.3	0.0	19.0
Mattawoman Cr	10.9	11.5	3.1	5.0	16.0
Nanjemoy Creek	7.6	8.0	4.0	2.0	13.0
St Mary's River	9.3	9.0	5.5	0.0	18.0
Brighton Dam	6.2	6.0	2.1	3.0	9.0
Little Patuxent	16.0	13.0	10.6	4.0	45.0
S Br Patapsco	3.1	2.5	2.2	1.0	8.0
Liberty Res	5.8	4.0	4.3	0.0	14.0
Patapsco L N Br	7.6	8.5	4.5	0.0	17.0
Prettyboy Res	2.8	2.5	2.2	0.0	7.0
ABPG/Swan Creek	2.8	2.0	4.2	0.0	14.0
Cors R/SE Cr	7.5	8.0	4.1	2.0	13.0
Upper Choptank	6.4	5.5	5.3	0.0	15.0
Lower Wico	54.7	26.5	63.9	0.0	150.0

Table B-26. Total Nitrogen (mg/L)					
	Mean	Median	Std Dev	Min	Max
Casselman River	0.82	0.61	0.62	0.15	1.82
Town Creek	0.32	0.28	0.26	0.08	0.93
Fifteen M Creek	0.43	0.35	0.31	0.19	1.25
PR Wa Co	2.04	0.70	2.28	0.23	7.13
Upper Monocacy	1.55	0.71	2.16	0.04	9.18
Mattawoman Cr	0.49	0.44	0.25	0.15	0.91
Nanjemoy Creek	0.26	0.25	0.17	0.04	0.54
St Mary's River	0.54	0.60	0.28	0.15	1.09
Brighton Dam	2.98	3.10	0.99	1.18	4.40
Little Patuxent	2.18	2.08	1.13	0.83	5.07
S Br Patapsco	4.16	3.79	2.16	0.87	8.05
Liberty Res	3.67	3.64	1.39	1.31	6.09
Patapsco L N Br	1.52	1.40	1.04	0.35	3.98
Prettyboy Res	4.73	5.04	1.42	2.65	6.58
ABPG/Swan Creek	0.85	0.81	0.22	0.51	1.28
Cors R/SE Cr	4.10	4.63	1.59	0.85	5.53
Upper Choptank	3.42	2.68	2.14	1.34	9.28
Lower Wico	2.06	1.74	1.05	1.11	4.20

Table B-27. Nitrate Nitrogen (mg/L)					
PSU	Mean	Median	Std Dev	Min	Max
Casselman River	0.60	0.44	0.56	0.01	1.56
Town Creek	0.20	0.17	0.24	0.00	0.78
Fifteen Mile Creek	0.31	0.25	0.26	0.10	0.97
PR Wa Co	1.75	0.54	2.06	0.09	6.29
Upper Monocacy	1.26	0.46	2.08	0.00	8.90
Mattawoman Cr	0.17	0.17	0.10	0.01	0.33
Nanjemoy Creek	0.03	0.00	0.07	0.00	0.23
St Mary's River	0.18	0.07	0.20	0.00	0.53
Brighton Dam	2.75	2.85	0.98	1.04	4.34
Little Patuxent	1.81	1.66	1.10	0.32	4.58
S Br Patapsco	3.90	3.47	2.10	0.77	7.70
Liberty Res	3.35	3.33	1.36	1.05	5.79
Patapsco L N Br	1.32	1.23	0.99	0.27	3.68
Prettyboy Res	4.49	4.83	1.36	2.45	6.39
ABPG/Swan Creek	0.30	0.32	0.29	0.00	0.91
Cors R/SE Cr	3.33	3.82	1.57	0.16	4.71
Upper Choptank	2.43	1.63	2.10	0.52	8.57
Lower Wico	1.26	0.96	1.16	0.00	3.85

Table B-28. Nitrite Nitrogen (mg/L)					
	Mean	Median	Std Dev	Min	Max
Casselman River	0.0006	0.0000	0.0020	0.0000	0.0062
Town Creek	0.0005	0.0000	0.0007	0.0000	0.0018
Fifteen M Creek	0.0000	0.0000	0.0000	0.0000	0.0000
PR Wa Co	0.0008	0.0000	0.0030	0.0000	0.0108
Upper Monocacy	0.0044	0.0000	0.0135	0.0000	0.0572
Mattawoman Cr	0.0080	0.0082	0.0039	0.0000	0.0138
Nanjemoy Creek	0.0073	0.0075	0.0015	0.0052	0.0093
St Mary's River	0.0096	0.0097	0.0019	0.0073	0.0141
Brighton Dam	0.0096	0.0092	0.0046	0.0000	0.0187
Little Patuxent	0.0090	0.0000	0.0226	0.0000	0.0827
S Br Patapsco	0.0135	0.0134	0.0048	0.0058	0.0227
Liberty Res	0.0189	0.0139	0.0125	0.0085	0.0561
Patapsco L N Br	0.0091	0.0092	0.0050	0.0000	0.0220
Prettyboy Res	0.0105	0.0097	0.0024	0.0082	0.0159
ABPG/Swan Creek	0.0000	0.0000	0.0000	0.0000	0.0000
Cors R/SE Cr	0.0108	0.0086	0.0104	0.0000	0.0283
Upper Choptank	0.0074	0.0017	0.0089	0.0000	0.0241
Lower Wico	0.0032	0.0000	0.0048	0.0000	0.0122

Table B-29. Ammonia (mg/L)					
	Mean	Median	Std Dev	Min	Max
Casselman River	0.0140	0.0000	0.0369	0.0000	0.1172
Town Creek	0.0091	0.0065	0.0101	0.0000	0.0262
Fifteen M Creek	0.0026	0.0000	0.0051	0.0000	0.0127
PR Wa Co	0.0128	0.0000	0.0195	0.0000	0.0505
Upper Monocacy	0.0418	0.0154	0.0758	0.0000	0.2832
Mattawoman Cr	0.0609	0.0423	0.0800	0.0112	0.2923
Nanjemoy Creek	0.0167	0.0148	0.0093	0.0061	0.0406
St Mary's River	0.0384	0.0284	0.0444	0.0019	0.1404
Brighton Dam	0.0167	0.0155	0.0091	0.0000	0.0265
Little Patuxent	0.0161	0.0122	0.0144	0.0000	0.0472
S Br Patapsco	0.0143	0.0136	0.0065	0.0063	0.0278
Liberty Res	0.0512	0.0166	0.1070	0.0000	0.4414
Patapsco L N Br	0.0202	0.0143	0.0211	0.0033	0.0815
Prettyboy Res	0.0157	0.0137	0.0089	0.0040	0.0347
ABPG/Swan Creek	0.0063	0.0016	0.0134	0.0000	0.0455
Cors R/SE Cr	0.0716	0.0505	0.0689	0.0000	0.2102
Upper Choptank	0.0819	0.0739	0.0717	0.0056	0.2064
Lower Wico	0.0649	0.0512	0.0559	0.0174	0.2058

Table B-30. Total Dissolved Nitrogen (mg/L)					
	Mean	Median	Std Dev	Min	Max
Casselman River	0.7907	0.5952	0.6216	0.1049	1.7867
Town Creek	0.3024	0.2671	0.2612	0.0673	0.9153
Fifteen M Creek	0.4173	0.3328	0.3136	0.1698	1.2405
PR Wa Co	1.9857	0.6863	2.2234	0.2191	6.9726
Upper Monocacy	1.4949	0.6466	2.1479	0.0377	9.1174
Mattawoman Cr	0.4464	0.3757	0.2079	0.1423	0.7958
Nanjemoy Creek	0.2216	0.1542	0.1695	0.0246	0.4798
St Mary's River	0.4684	0.5412	0.2494	0.1390	0.8758
Brighton Dam	2.9355	3.0653	1.0039	1.1183	4.3817
Little Patuxent	2.1177	2.0141	1.1303	0.7014	5.0262
S Br Patapsco	4.1302	3.7065	2.1550	0.8620	8.0174
Liberty Res	3.6195	3.5067	1.3815	1.2812	5.9670
Patapsco L N Br	1.4935	1.3809	1.0505	0.3039	3.9725
Prettyboy Res	4.6795	4.9930	1.4228	2.5784	6.5380
ABPG/Swan Creek	0.7510	0.7829	0.2050	0.4617	1.1580
Cors R/SE Cr	4.0117	4.5195	1.5777	0.7910	5.4228
Upper Choptank	3.2934	2.6217	2.0905	1.2398	9.2337
Lower Wico	1.9434	1.6249	1.0593	0.9975	4.1535

Table B-31. Particulate Nitrogen (mg/L)					
	Mean	Median	Std Dev	Min	Max
Casselman River	0.0243	0.0226	0.0092	0.0108	0.0408
Town Creek	0.0131	0.0119	0.0040	0.0091	0.0207
Fifteen M Creek	0.0147	0.0137	0.0054	0.0095	0.0259
PR Wa Co	0.0515	0.0216	0.0580	0.0038	0.1664
Upper Monocacy	0.0525	0.0387	0.0426	0.0026	0.1712
Mattawoman Cr	0.0467	0.0252	0.0695	0.0028	0.2453
Nanjemoy Creek	0.0433	0.0264	0.0607	0.0077	0.2102
St Mary's River	0.0734	0.0568	0.0600	0.0126	0.2125
Brighton Dam	0.0429	0.0310	0.0286	0.0164	0.1122
Little Patuxent	0.0591	0.0530	0.0298	0.0248	0.1274
S Br Patapsco	0.0325	0.0203	0.0455	0.0063	0.1588
Liberty Res	0.0463	0.0159	0.0818	0.0010	0.3286
Patapsco L N Br	0.0236	0.0199	0.0208	0.0000	0.0812
Prettyboy Res	0.0472	0.0406	0.0202	0.0219	0.0841
ABPG/Swan Creek	0.0972	0.1007	0.0450	0.0250	0.1575
Cors R/SE Cr	0.0919	0.0862	0.0479	0.0410	0.2035
Upper Choptank	0.1315	0.0705	0.2306	0.0247	0.9236
Lower Wico	0.1129	0.0845	0.0789	0.0456	0.2533

Table B-32. NO3-N > 1 mg/L			
PSU	Percentage of Stream Miles with NO3-N > 1 mg/L	Lower 90% CI	Upper 90% CI
Casselman River	30	6.16	53.84
Town Creek	0	0	25.89
Fifteen M Creek	0	0	25.89
PR Wa CO	38.46	16.57	64.52
Upper Monocacy	27.78	11.64	49.78
Mattawoman Cr	0	0	25.89
Nanjemoy Creek	0	0	25.89
St Mary's River	0	0	23.84
Brighton Dam	100	76.16	100
Little Patuxent	76.92	50.54	93.4
S Br Patapsco	90.91	63.56	99.53
Liberty Res	100	82.93	100
Patapsco L N Br	53.33	30	75.63
Prettyboy Res	100	74.11	100
ABPG/Swan Creek	0	0	23.84
Cors R/SE Cr	90	60.58	99.49
Upper Choptank	78.57	53.43	93.89
Lower Wico	40	15	69.65

Table B-33. Total Phosphorus (mg/L)					
PSU	Mean	Median	Std Dev	Min	Max
Casselman River	0.0075	0.0068	0.0032	0.0038	0.0143
Town Creek	0.0059	0.0052	0.0018	0.0041	0.0099
Fifteen M Creek	0.0052	0.0055	0.0021	0.0016	0.0080
PR Wa Co	0.0117	0.0068	0.0109	0.0042	0.0400
Upper Monocacy	0.0221	0.0103	0.0287	0.0030	0.0907
Mattawoman Cr	0.0220	0.0169	0.0176	0.0074	0.0656
Nanjemoy Creek	0.0121	0.0113	0.0038	0.0088	0.0214
St Mary's River	0.0181	0.0196	0.0090	0.0072	0.0331
Brighton Dam	0.0122	0.0112	0.0065	0.0057	0.0291
Little Patuxent	0.0753	0.0173	0.1845	0.0066	0.6820
S Br Patapsco	0.0155	0.0114	0.0099	0.0064	0.0382
Liberty Res	0.0128	0.0102	0.0061	0.0062	0.0267
Patapsco L N Br	0.0293	0.0123	0.0706	0.0053	0.2839
Prettyboy Res	0.0133	0.0126	0.0026	0.0106	0.0189
ABPG/Swan Creek	0.0428	0.0360	0.0341	0.0091	0.0944
Cors R/SE Cr	0.0654	0.0567	0.0232	0.0315	0.1049
Upper Choptank	0.0646	0.0553	0.0371	0.0198	0.1715
Lower Wico	0.0821	0.0443	0.1163	0.0101	0.3978

Table B-34. Orthophosphate (mg/L)					
PSU	Mean	Median	Std Dev	Min	Max
Casselman River	0.0010	0.0005	0.0013	0.0000	0.0035
Town Creek	0.0010	0.0004	0.0014	0.0000	0.0045
Fifteen M Creek	0.0007	0.0006	0.0006	0.0000	0.0022
PR Wa Co	0.0017	0.0007	0.0033	0.0000	0.0122
Upper Monocacy	0.0114	0.0028	0.0195	0.0000	0.0640
Mattawoman Cr	0.0019	0.0025	0.0013	0.0000	0.0037
Nanjemoy Creek	0.0019	0.0025	0.0013	0.0001	0.0038
St Mary's River	0.0050	0.0046	0.0007	0.0046	0.0067
Brighton Dam	0.0030	0.0022	0.0045	0.0001	0.0163
Little Patuxent	0.0547	0.0030	0.1594	0.0000	0.5782
S Br Patapsco	0.0077	0.0037	0.0088	0.0012	0.0284
Liberty Res	0.0048	0.0046	0.0029	0.0025	0.0121
Patapsco L N Br	0.0035	0.0025	0.0040	0.0000	0.0148
Prettyboy Res	0.0052	0.0049	0.0017	0.0025	0.0077
ABPG/Swan Creek	0.0165	0.0057	0.0201	0.0011	0.0525
Cors R/SE Cr	0.0258	0.0265	0.0139	0.0065	0.0523
Upper Choptank	0.0232	0.0153	0.0268	0.0005	0.1037
Lower Wico	0.0576	0.0193	0.1058	0.0006	0.3496

Table B-35. Total Dissolved Phosphorus (mg/L)					
PSU	Mean	Median	Std Dev	Min	Max
Casselman River	0.0064	0.0057	0.0030	0.0027	0.0133
Town Creek	0.0055	0.0049	0.0015	0.0039	0.0087
Fifteen M Creek	0.0050	0.0054	0.0021	0.0016	0.0080
PR Wa Co	0.0084	0.0061	0.0072	0.0029	0.0296
Upper Monocacy	0.0182	0.0085	0.0240	0.0029	0.0793
Mattawoman Cr	0.0149	0.0097	0.0138	0.0058	0.0528
Nanjemoy Creek	0.0088	0.0084	0.0025	0.0059	0.0138
St Mary's River	0.0129	0.0141	0.0056	0.0067	0.0216
Brighton Dam	0.0094	0.0083	0.0052	0.0047	0.0238
Little Patuxent	0.0629	0.0109	0.1608	0.0050	0.5911
S Br Patapsco	0.0130	0.0096	0.0091	0.0053	0.0340
Liberty Res	0.0097	0.0081	0.0045	0.0043	0.0215
Patapsco L N Br	0.0264	0.0085	0.0709	0.0044	0.2826
Prettyboy Res	0.0106	0.0105	0.0026	0.0072	0.0147
ABPG/Swan Creek	0.0351	0.0287	0.0280	0.0082	0.0789
Cors R/SE Cr	0.0483	0.0431	0.0195	0.0188	0.0852
Upper Choptank	0.0398	0.0317	0.0284	0.0076	0.1197
Lower Wico	0.0756	0.0370	0.1134	0.0096	0.3870

Table B-36. Particulate Phosphorus (mg/L)					
PSU	Mean	Median	Std Dev	Min	Max
Casselman River	0.0011	0.0010	0.0005	0.0003	0.0021
Town Creek	0.0004	0.0003	0.0003	0.0000	0.0012
Fifteen M Creek	0.0003	0.0001	0.0003	0.0000	0.0008
PR Wa Co	0.0033	0.0010	0.0044	0.0002	0.0127
Upper Monocacy	0.0040	0.0019	0.0064	0.0000	0.0266
Mattawoman Cr	0.0071	0.0046	0.0052	0.0016	0.0179
Nanjemoy Creek	0.0033	0.0028	0.0022	0.0008	0.0076
St Mary's River	0.0052	0.0036	0.0046	0.0005	0.0163
Brighton Dam	0.0028	0.0026	0.0017	0.0010	0.0053
Little Patuxent	0.0124	0.0058	0.0239	0.0013	0.0909
S Br Patapsco	0.0025	0.0019	0.0015	0.0008	0.0053
Liberty Res	0.0030	0.0019	0.0034	0.0008	0.0142
Patapsco L N Br	0.0029	0.0021	0.0022	0.0006	0.0085
Prettyboy Res	0.0027	0.0028	0.0009	0.0015	0.0042
ABPG/Swan Creek	0.0077	0.0073	0.0066	0.0007	0.0183
Cors R/SE Cr	0.0171	0.0157	0.0060	0.0073	0.0276
Upper Choptank	0.0248	0.0202	0.0171	0.0036	0.0572
Lower Wico	0.0064	0.0019	0.0069	0.0005	0.0179

Table B-37. Dissolved Oxygen (mg/L)					
PSU	Mean	Median	Std Dev	Min	Max
Casselman River	7.73	7.80	0.82	6.00	8.60
Town Creek	7.19	7.30	1.36	5.50	8.60
Fifteen Mile Creek	7.00	6.95	0.93	5.50	8.10
PR Wa Co	8.19	8.40	0.57	7.20	8.90
Upper Monocacy	7.65	7.50	1.14	5.70	9.60
Mattawoman Cr	6.76	6.90	0.55	5.30	7.30
Nanjemoy Creek	5.39	5.75	2.14	1.20	7.80
St Mary's River	7.13	7.20	2.24	3.00	9.80
Brighton Dam	8.05	8.20	0.38	7.10	8.40
Little Patuxent	7.77	7.50	1.10	6.20	9.60
S Br Patapsco	8.00	8.25	0.81	6.60	9.30
Liberty Res	8.41	8.45	0.56	7.20	9.40
Patapsco L N Br	7.72	7.80	0.97	6.20	9.00
Prettyboy Res	8.97	9.05	0.55	8.10	9.90
ABPG/Swan Creek	6.11	4.50	4.38	1.10	16.30
Cors R/SE Cr	5.74	5.95	1.52	2.60	7.70
Upper Choptank	5.81	6.70	2.49	0.80	8.30
Lower Wico	4.31	5.00	1.99	0.30	6.80

Table B-38. DO < 5 mg/L			
PSU	Percentage of Stream Miles with DO < 5 mg/L	Lower 90% CI	Upper 90% CI
Casselman River	0.0	0.0	25.9
Town Creek	0.0	0.0	31.2
Fifteen M Creek	0.0	0.0	31.2
PR Wa CO	0.0	0.0	22.1
Upper Monocacy	0.0	0.0	16.2
Mattawoman Cr	0.0	0.0	25.9
Nanjemoy Creek	30.0	8.7	60.7
St Mary's River	11.1	0.6	42.9
Brighton Dam	0.0	0.0	23.8
Little Patuxent	0.0	0.0	20.6
S Br Patapsco	0.0	0.0	23.8
Liberty Res	0.0	0.0	17.1
Patapsco L N Br	0.0	0.0	20.6
Prettyboy Res	0.0	0.0	25.9
ABPG/Swan Creek	55.6	25.1	83.1
Cors R/SE Cr	20.0	3.7	50.7
Upper Choptank	21.4	6.1	46.6
Lower Wico	50.0	22.2	77.8

Table B-39. Summer Turbidity (NTU)					
PSU	Mean	Median	Std Dev	Min	Max
Casselman River	2.43	2.45	1.27	0.50	4.40
Town Creek	3.13	2.40	2.38	0.60	8.50
Fifteen Mile Creek	1.88	1.80	0.89	0.60	3.20
PR Wa Co	6.74	6.05	4.59	0.80	15.40
Upper Monocacy	3.56	3.10	2.82	0.30	9.90
Mattawoman Cr	10.08	8.75	4.34	3.30	18.90
Nanjemoy Creek	10.83	8.85	7.26	3.00	26.50
St Mary's River	12.07	7.90	9.61	5.00	30.80
Brighton Dam	6.51	5.30	3.94	1.10	14.00
Little Patuxent	9.38	4.70	8.31	1.40	26.20
S Br Patapsco	4.24	4.05	0.85	3.30	5.90
Liberty Res	4.78	4.05	3.25	1.70	13.40
Patapsco L N Br	5.75	5.20	6.13	0.00	22.30
Prettyboy Res	5.58	5.15	2.23	3.10	10.50
ABPG/Swan Creek	20.80	12.00	21.33	3.40	55.10
Cors R/SE Cr	10.55	7.30	11.35	4.30	42.00
Upper Choptank	10.58	9.85	8.64	1.90	36.50
Lower Wico	3.48	2.90	1.47	2.10	5.90

Table B-40. Sulfate (mg/L)					
PSU	Mean	Median	Std Dev	Min	Max
Casselman River	17.32	16.92	5.85	9.52	26.28
Town Creek	14.03	13.48	3.82	9.82	24.19
Fifteen Mile Creek	10.46	10.53	1.76	7.83	13.35
PR Wa Co	33.38	24.31	26.48	8.06	101.96
Upper Monocacy	10.18	7.66	5.88	2.77	22.56
Mattawoman Cr	9.18	9.27	2.56	3.22	12.36
Nanjemoy Creek	5.26	4.92	2.46	1.72	10.79
St Mary's River	9.69	10.40	3.57	5.04	14.64
Brighton Dam	5.34	5.19	2.73	2.19	12.11
Little Patuxent	14.09	17.04	6.31	1.74	20.22
S Br Patapsco	8.64	5.83	6.89	3.82	26.59
Liberty Res	7.33	5.85	5.22	2.76	24.19
Patapsco L N Br	25.84	24.90	6.07	13.68	35.40
Prettyboy Res	6.57	6.37	2.06	3.75	10.22
ABPG/Swan Creek	8.10	8.06	1.93	5.57	11.41
Cors R/SE Cr	14.34	13.98	6.31	5.44	23.82
Upper Choptank	13.32	12.53	6.09	3.81	24.30
Lower Wico	7.13	6.26	3.72	1.59	14.35

Table B-41. Chloride (mg/L)					
PSU	Mean	Median	Std Dev	Min	Max
Casselman River	99.78	13.36	144.76	0.82	379.30
Town Creek	2.88	3.04	1.83	0.86	5.05
Fifteen Mile Creek	4.69	3.74	3.48	0.81	8.72
PR Wa Co	34.24	39.26	24.91	1.52	84.31
Upper Monocacy	12.38	11.19	8.20	1.07	34.50
Mattawoman Cr	35.38	31.60	23.20	3.15	64.20
Nanjemoy Creek	9.30	6.98	5.95	2.95	18.08
St Mary's River	18.12	14.14	18.51	6.79	72.73
Brighton Dam	17.55	16.81	6.74	5.41	31.65
Little Patuxent	47.94	46.50	19.50	21.64	94.34
S Br Patapsco	22.80	20.14	6.62	14.73	36.69
Liberty Res	28.43	24.94	15.60	12.64	73.94
Patapsco L N Br	61.80	73.02	22.85	16.81	91.75
Prettyboy Res	27.23	25.24	10.88	16.76	53.74
ABPG/Swan Creek	16.30	11.64	11.42	1.76	38.65
Cors R/SE Cr	20.94	23.93	7.65	6.52	31.26
Upper Choptank	13.81	12.77	4.71	5.85	26.89
Lower Wico	8.84	9.37	4.66	3.34	17.65

Table B-42. Dissolved Organic Carbon (mg/L)					
	Mean	Median	Std Dev	Min	Max
Casselman River	1.7712	1.5974	0.7581	0.9069	3.7080
Town Creek	1.9934	1.8628	0.5418	1.0884	2.9480
Fifteen M Creek	1.4438	1.3250	0.2315	1.1513	1.7946
PR Wa Co	1.9844	1.5750	0.8808	0.9223	3.6781
Upper Monocacy	3.0767	2.1847	2.2765	0.8271	8.2780
Mattawoman Cr	4.5214	3.2399	2.7379	1.8036	9.6551
Nanjemoy Creek	5.6833	4.0601	4.0490	1.6481	14.1260
St Mary's River	7.2732	4.2424	8.9275	2.3138	33.3840
Brighton Dam	1.3537	1.4345	0.3767	0.8616	2.0639
Little Patuxent	2.5558	2.3868	1.3521	0.9379	6.4538
S Br Patapsco	1.2595	1.2293	0.2873	0.8567	1.7841
Liberty Res	1.3995	1.2974	0.4460	0.8666	2.3787
Patapsco L N Br	2.1788	2.0399	0.9819	1.0164	5.1821
Prettyboy Res	1.1977	1.1745	0.3290	0.8138	1.9322
ABPG/Swan Creek	9.3726	7.5589	5.1951	2.0895	17.9050
Cors R/SE Cr	9.3211	8.0850	3.6555	5.0860	17.3841
Upper Choptank	10.8557	8.8235	6.7249	5.3558	30.6940
Lower Wico	18.3250	16.8818	10.2072	6.9244	41.7570

Table B-43. Particulate Carbon (mg/L)					
PSU	Mean	Median	Std Dev	Min	Max
Casselman River	0.3360	0.2932	0.1546	0.2069	0.7407
Town Creek	0.1293	0.0975	0.0674	0.0669	0.2461
Fifteen M Creek	0.1343	0.1087	0.0611	0.0740	0.2555
PR Wa Co	0.8207	0.2179	1.0626	0.0857	2.7924
Upper Monocacy	0.4158	0.3562	0.3053	0.0377	1.2628
Mattawoman Cr	0.6780	0.5622	0.5585	0.1613	2.2216
Nanjemoy Creek	1.1559	0.7717	1.2917	0.1949	4.4648
St Mary's River	0.9301	0.7841	0.7662	0.1546	2.7393
Brighton Dam	0.3579	0.2686	0.2147	0.1318	0.8107
Little Patuxent	0.4235	0.3867	0.2477	0.1179	1.1468
S Br Patapsco	0.1768	0.1857	0.0516	0.0679	0.2380
Liberty Res	0.3656	0.1968	0.4592	0.0466	1.8883
Patapsco L N Br	0.2783	0.2161	0.2052	0.0967	0.9505
Prettyboy Res	0.4164	0.4132	0.1855	0.1500	0.6818
ABPG/Swan Creek	0.7857	0.8287	0.4729	0.1780	1.3995
Cors R/SE Cr	0.9236	0.8716	0.3424	0.5292	1.7273
Upper Choptank	1.6524	0.8289	2.5461	0.4260	10.3579
Lower Wico	0.9446	1.0645	0.3273	0.4673	1.2774

APPENDIX C

SUMMARY OF TEMPERATURE LOGGER DATA

Table C-1. Summary indicator statistics calculated from temperature loggers. Notes indicate special circumstances encountered in deploying or retrieving temp logger.

Site	Mean Average Daily Temperature	Mean Minimum Daily Temperature	Mean Maximum Daily Temperature	Absolute Maximum	95th Percentile	Percent Exceedences 20 °C	Percent Exceedences 23.9 °C	Percent Exceedences 32 °C	Notes
ABPG-103-R-2000									Temperature logger dry when retrieved
ABPG-108-R-2000									Temperature logger dry when retrieved
ABPG-113-R-2000									Temperature logger dry when retrieved
ABPG-118-R-2000									Temperature logger dry when retrieved
ABPG-119-R-2000									Temperature logger dry when retrieved
ABPG-214-R-2000									No temperature logger - site was located in beaver dam
ABPG-302-R-2000	22.82	20.27	26.26	34.03	27.97	82.14	36.85	0.02	
SWAN-104-R-2000	20.59	18.55	22.81	28.83	24.93	59.11	10.95	0.00	
SWAN-105-R-2000	20.40	18.94	21.91	25.40	23.67	59.02	3.33	0.00	
SWAN-106-R-2000									Temperature logger dry all summer
SWAN-110-R-2000	21.65	18.80	25.10	30.02	26.76	67.10	23.38	0.00	
BRIG-105-R-2000	17.73	16.35	19.35	23.34	20.19	7.73	0.00	0.00	
BRIG-111-R-2000	17.90	16.84	19.05	23.20	20.22	6.85	0.00	0.00	
BRIG-115-R-2000	18.82	17.76	19.85	22.34	21.02	24.35	0.00	0.00	
BRIG-123-R-2000	19.72	17.54	22.25	25.62	23.55	42.99	2.39	0.00	
BRIG-131-R-2000	21.47	19.70	23.47	27.07	24.79	75.96	13.47	0.00	
BRIG-132-R-2000	17.77	17.21	18.36	22.07	20.26	7.90	0.00	0.00	
BRIG-206-R-2000	18.55	16.55	20.72	24.03	21.85	26.41	0.11	0.00	
BRIG-212-R-2000	19.05	17.77	20.34	23.01	21.34	31.55	0.00	0.00	
BRIG-218-R-2000	19.33	17.93	20.76	23.86	21.99	40.03	0.00	0.00	
BRIG-307-R-2000	19.12	17.91	20.40	23.28	21.45	30.51	0.00	0.00	
BRIG-308-R-2000	19.09	17.90	20.28	23.08	21.58	32.37	0.00	0.00	
CASS-101-R-2000	18.08	15.45	21.37	29.92	22.69	25.77	1.85	0.00	
CASS-102-R-2000	13.93	13.27	14.53	18.10	15.56	0.00	0.00	0.00	
CASS-104-R-2000									Temperature logger lost
CASS-105-R-2000	16.18	14.24	18.52	28.68	19.31	2.01	0.04	0.00	
CASS-106-R-2000	16.64	14.11	19.26	23.27	20.29	6.76	0.00	0.00	
CASS-109-R-2000	19.15	16.24	21.52	25.10	23.03	45.15	0.97	0.00	
CASS-110-R-2000	15.08	13.97	16.29	19.09	17.48	0.00	0.00	0.00	
CASS-111-R-2000	13.70	13.54	13.93	15.77	15.29	0.00	0.00	0.00	
CASS-113-R-2000	19.15	16.24	21.52	25.10	23.03	45.15	0.97	0.00	
CASS-307-R-2000	18.77	16.54	21.67	25.61	23.20	30.41	2.76	0.00	
CORS-102-R-2000	20.85	19.53	22.22	25.39	24.01	68.98	5.89	0.00	
CORS-106-R-2000	22.22	20.80	23.86	27.07	25.32	87.33	20.91	0.00	
CORS-107-R-2000	21.10	20.00	22.24	25.04	24.01	76.06	5.50	0.00	
CORS-108-R-2000	20.66	19.59	21.76	24.52	23.49	68.31	1.68	0.00	
CORS-205-R-2000	19.44	18.57	20.34	22.38	21.38	36.50	0.00	0.00	
SEAS-109-R-2000	19.48	18.52	20.53	23.41	22.23	40.80	0.00	0.00	
SEAS-111-R-2000	19.97	18.93	20.97	23.69	22.52	53.30	0.00	0.00	
SEAS-113-R-2000	20.26	19.01	21.58	24.62	23.08	55.88	1.50	0.00	
SEAS-116-R-2000	21.91	20.21	23.72	27.46	25.34	79.80	20.05	0.00	
SEAS-120-R-2000									Temperature logger dry when retrieved

Table C-1. (Continued)									
Site	Mean Average Daily Temperature	Mean Minimum Daily Temperature	Mean Maximum Daily Temperature	Absolute Maximum	95th Percentile	Percent Exceedences 20 °C	Percent Exceedences 23.9 °C	Percent Exceedences 32 °C	Notes
FIMI-103-R-2000									No temperature logger - stream was very small
FIMI-105-R-2000									No temperature logger - stream was very small
FIMI-106-R-2000	17.33	16.66	17.99	20.14	19.33	0.09	0.00	0.00	
FIMI-108-R-2000	17.58	16.41	18.76	21.12	19.83	2.85	0.00	0.00	
FIMI-109-R-2000	18.02	16.65	19.52	22.41	20.60	11.70	0.00	0.00	
FIMI-110-R-2000	18.02	16.65	19.52	22.41	20.60	11.70	0.00	0.00	
FIMI-202-R-2000	18.02	16.65	19.52	22.41	20.60	11.70	0.00	0.00	
FIMI-401-R-2000									Temperature logger was dry at end of summer
FIMI-404-R-2000	21.26	19.46	23.22	27.17	25.08	73.70	15.79	0.00	
FIMI-407-R-2000	21.26	19.46	23.22	27.17	25.08	73.70	15.79	0.00	
LIBE-101-R-2000	17.24	16.02	18.93	22.03	20.22	6.82	0.00	0.00	
LIBE-104-R-2000									Temperature logger lost
LIBE-110-R-2000	17.75	16.43	19.25	21.91	20.27	7.57	0.00	0.00	
LIBE-111-R-2000	18.62	16.91	20.55	23.65	21.64	26.34	0.00	0.00	
LIBE-113-R-2000									Temperature logger was dry when retrieved
LIBE-115-R-2000	17.17	16.14	18.34	21.04	19.26	1.13	0.00	0.00	
LIBE-117-R-2000	19.57	18.45	20.72	24.09	22.07	42.20	0.18	0.00	
LIBE-119-R-2000	19.79	17.03	23.11	27.18	24.57	43.68	8.41	0.00	
LIBE-202-R-2000	19.22	17.91	20.64	23.61	21.94	35.35	0.00	0.00	
LIBE-203-R-2000									Temperature logger lost
LIBE-207-R-2000									Temperature logger lost
LIBE-209-R-2000	18.58	17.04	20.67	23.82	21.64	25.90	0.00	0.00	
LIBE-212-R-2000	17.21	16.22	18.25	20.22	19.24	0.88	0.00	0.00	
LIBE-216-R-2000	17.95	17.03	18.96	21.43	20.28	6.51	0.00	0.00	
LIBE-303-R-2000	19.66	18.12	21.43	24.61	22.73	45.07	1.06	0.00	
LIBE-318-R-2000	19.07	17.45	20.75	23.79	21.94	32.85	0.00	0.00	
LOWI-102-R-2000	21.40	19.36	24.42	32.32	25.74	70.96	16.07	0.02	
LOWI-103-R-2000	20.92	19.48	23.20	30.06	24.55	69.26	7.60	0.00	
LOWI-104-R-2000	20.53	20.09	21.08	23.29	22.44	72.16	0.00	0.00	
LOWI-113-R-2000									Temperature logger lost
MONI-126-R-2000									Temperature logger dry when retrieved
WIRH-103-R-2000	20.92	19.48	23.20	30.06	24.55	69.26	7.60	0.00	
WIRH-108-R-2000	24.50	23.19	25.96	29.58	27.57	96.55	61.94	0.00	
WIRH-109-R-2000	20.92	18.31	23.26	28.33	25.33	66.09	12.61	0.00	
WIRH-111-R-2000	20.20	19.01	21.39	25.47	23.06	59.40	1.81	0.00	
WIRH-215-R-2000	22.12	20.45	24.15	27.44	25.85	82.86	20.69	0.00	
LPAX-109-R-2000	16.64	15.52	18.03	21.49	18.72	0.27	0.00	0.00	
LPAX-112-R-2000	19.55	18.56	20.79	24.76	21.87	42.26	0.09	0.00	
LPAX-113-R-2000	20.93	19.99	22.00	24.92	23.54	75.03	2.23	0.00	
LPAX-115-R-2000									Temperature logger lost
LPAX-116-R-2000	19.67	18.68	20.84	24.37	22.33	47.07	0.07	0.00	
LPAX-118-R-2000	22.52	21.27	24.31	31.26	25.65	88.43	27.93	0.00	
LPAX-203-R-2000	18.91	17.96	20.07	24.01	20.99	25.48	0.02	0.00	
LPAX-204-R-2000	20.37	19.26	21.56	24.36	23.16	61.25	0.90	0.00	
LPAX-206-R-2000									Temperature logger lost
LPAX-217-R-2000	20.72	19.38	22.02	25.27	23.54	66.51	2.58	0.00	
LPAX-311-R-2000	21.57	20.51	22.80	25.77	24.38	83.35	8.63	0.00	
LPAX-401-R-2000	22.19	21.23	23.19	25.72	24.51	90.82	14.09	0.00	
LPAX-408-R-2000	21.91	20.97	22.86	25.36	24.14	88.58	8.96	0.00	

Table C-1. (Continued)									
Site	Mean Average Daily Temperature	Mean Minimum Daily Temperature	Mean Maximum Daily Temperature	Absolute Maximum	95th Percentile	Percent Exceedences 20 °C	Percent Exceedences 23.9 °C	Percent Exceedences 32 °C	Notes
LTON-102-R-2000									Temperature logger lost
LTON-108-R-2000	22.15	20.39	24.34	27.67	25.39	84.39	20.71	0.00	
LTON-113-R-2000	20.02	18.13	22.51	26.32	23.55	51.29	3.47	0.00	
LTON-114-R-2000	17.53	16.22	19.05	24.40	20.23	6.56	0.02	0.00	
MARS-205-R-2000	19.49	17.52	21.71	25.62	22.86	40.52	1.24	0.00	
MARS-210-R-2000	17.22	15.01	19.90	22.87	21.04	12.67	0.00	0.00	
MARS-224-R-2000	19.49	17.52	21.71	25.62	22.86	40.52	1.24	0.00	
PRWA-103-R-2000	19.76	17.83	21.94	25.27	23.04	47.80	0.91	0.00	
PRWA-104-R-2000	18.66	17.44	19.98	22.50	21.18	23.32	0.00	0.00	
PRWA-106-R-2000	17.88	15.90	19.84	23.42	21.08	13.23	0.00	0.00	
PRWA-117-R-2000									No temperature logger - stream very small
PRWA-119-R-2000									Temperature logger lost
PRWA-122-R-2000	18.57	16.62	22.10	32.46	21.92	23.62	0.77	0.02	
MATT-103-R-2000	23.49	21.41	26.08	29.53	27.71	92.25	43.08	0.00	
MATT-104-R-2000	19.11	18.59	19.68	22.10	20.61	21.04	0.00	0.00	
MATT-105-R-2000	20.55	19.77	21.37	24.10	22.91	67.12	0.49	0.00	
MATT-108-R-2000	20.55	19.77	21.37	24.10	22.91	67.12	0.49	0.00	
MATT-109-R-2000	21.45	20.64	22.44	26.09	24.01	86.22	5.76	0.00	
MATT-115-R-2000	20.88	20.20	22.39	28.42	23.68	78.12	4.44	0.00	
MATT-117-R-2000	18.04	17.08	19.05	22.64	20.33	9.08	0.00	0.00	
MATT-210-R-2000	22.81	21.45	24.25	28.01	25.72	92.56	30.73	0.00	
MATT-212-R-2000	21.02	20.03	22.00	26.50	23.73	74.78	3.47	0.00	
MATT-216-R-2000	22.81	21.45	24.25	28.01	25.72	92.56	30.73	0.00	
MATT-320-R-2000	23.98	22.11	25.92	30.46	27.89	95.59	52.18	0.00	
NANJ-104-R-2000	19.37	18.52	20.26	22.89	21.55	37.87	0.00	0.00	
NANJ-109-R-2000									No temperature logger - stream is intermittent
NANJ-111-R-2000	19.37	18.52	20.26	22.89	21.55	37.87	0.00	0.00	Temperature logger data is used from site 104
NANJ-112-R-2000									Temperature logger lost
NANJ-115-R-2000									Temperature logger lost
NANJ-117-R-2000									No temperature logger - stream is intermittent
NANJ-119-R-2000	20.93	18.87	23.42	26.97	24.88	62.53	10.80	0.00	
NANJ-205-R-2000	22.73	21.18	24.34	27.63	25.87	91.14	29.57	0.00	
NANJ-206-R-2000									Temperature logger lost
NANJ-308-R-2000	22.69	21.36	24.08	27.89	25.77	91.59	26.49	0.00	
PATL-103-R-2000	21.40	20.02	23.06	28.03	24.53	79.02	9.72	0.00	
PATL-105-R-2000									Temperature logger lost
PATL-106-R-2000	16.75	15.83	18.54	27.18	18.61	1.33	0.20	0.00	
PATL-109-R-2000	19.57	17.66	22.08	25.62	22.87	40.21	1.02	0.00	
PATL-111-R-2000	19.90	18.97	21.19	26.94	22.79	47.27	1.17	0.00	
PATL-114-R-2000	20.11	18.82	21.52	25.77	23.03	55.49	1.08	0.00	
PATL-116-R-2000	20.27	18.90	22.36	25.90	23.32	58.18	1.92	0.00	
PATL-118-R-2000									Temperature logger dry when retrieved
PATL-119-R-2000	19.86	19.00	20.70	24.37	22.33	50.74	0.15	0.00	
PATL-124-R-2000	18.09	17.10	19.16	21.67	20.03	6.89	0.00	0.00	
PATL-127-R-2000	19.72	18.70	20.78	25.19	22.29	44.67	0.20	0.00	
PATL-202-R-2000									No temperature logger - only benthic data sampled
PATL-207-R-2000	20.04	18.91	21.41	26.64	22.68	55.31	0.35	0.00	
PATL-222-R-2000	21.75	20.32	23.28	26.45	24.88	82.27	14.11	0.00	
PATL-317-R-2000	21.40	20.13	22.89	25.61	24.22	80.68	8.19	0.00	

Table C-1. (Continued)

Site	Mean Average Daily Temperature	Mean Minimum Daily Temperature	Mean Maximum Daily Temperature	Absolute Maximum	95th Percentile	Percent Exceedences 20 °C	Percent Exceedences 23.9 °C	Percent Exceedences 32 °C	Notes
PRET-101-R-2000	17.27	16.35	18.33	27.40	19.29	1.13	0.15	0.00	Deployed on 6/12/00
PRET-102-R-2000	17.39	16.91	18.02	26.98	18.89	0.82	0.02	0.00	Deployed on 6/13/00
PRET-104-R-2000	16.39	15.22	17.76	20.44	18.67	0.29	0.00	0.00	
PRET-108-R-2000	16.78	15.58	18.16	26.83	18.78	0.46	0.12	0.00	Deployed on 6/8/00
PRET-109-R-2000	18.72	16.54	21.20	24.90	22.52	30.41	0.66	0.00	
PRET-110-R-2000	17.72	16.44	19.12	21.93	20.28	6.43	0.00	0.00	
PRET-112-R-2000	17.02	15.94	18.29	20.83	19.38	1.86	0.00	0.00	
PRET-113-R-2000	18.06	16.49	19.88	23.04	21.05	15.57	0.00	0.00	
PRET-122-R-2000	17.02	15.94	18.29	20.83	19.38	1.86	0.00	0.00	
PRET-214-R-2000	18.57	16.91	20.34	23.76	21.43	22.48	0.00	0.00	
SBPA-103-R-2000	17.16	15.68	19.20	22.88	19.91	4.55	0.00	0.00	
SBPA-104-R-2000	17.17	16.14	18.20	20.79	19.17	0.13	0.00	0.00	
SBPA-105-R-2000	17.68	16.61	18.69	20.96	19.98	3.60	0.00	0.00	
SBPA-108-R-2000	18.72	17.82	19.68	21.87	20.72	19.17	0.00	0.00	
SBPA-109-R-2000	18.15	16.93	19.72	23.02	21.03	15.30	0.00	0.00	
SBPA-113-R-2000	18.27	16.92	20.06	23.44	20.94	16.45	0.00	0.00	
SBPA-117-R-2000	20.33	18.87	21.89	25.33	23.43	56.15	2.49	0.00	
SBPA-207-R-2000	18.00	16.97	18.90	21.17	20.19	7.24	0.00	0.00	
SBPA-329-R-2000	19.54	18.41	20.66	23.22	22.21	42.53	0.00	0.00	
SBPA-424-R-2000	20.07	19.20	20.96	23.13	22.30	54.40	0.00	0.00	
STMA-101-R-2000	18.61	16.99	20.42	24.08	23.22	24.85	1.21	0.00	
STMA-104-R-2000	21.92	20.51	23.42	29.59	25.64	78.12	22.04	0.00	
STMA-108-R-2000	20.40	19.61	21.26	24.06	22.87	63.24	0.33	0.00	
STMA-110-R-2000	20.11	19.35	20.85	23.41	22.40	60.65	0.00	0.00	
STMA-111-R-2000	20.83	19.88	21.73	24.33	23.31	72.03	1.06	0.00	
STMA-112-R-2000	20.85	19.84	22.09	25.94	23.36	73.61	1.55	0.00	
STMA-113-R-2000	21.10	19.77	22.49	26.09	24.02	75.42	5.59	0.00	
STMA-116-R-2000									Temperature logger dry when retrieved
STMA-202-R-2000	23.83	22.16	25.58	30.33	27.58	94.61	51.14	0.00	
STMA-203-R-2000									No temperature logger - stream impounded
STMA-306-R-2000	22.47	20.89	24.05	26.88	25.66	89.36	27.18	0.00	
TOWN-101-R-2000	19.26	16.21	22.86	26.81	24.21	41.09	6.01	0.00	
TOWN-102-R-2000									Temperature logger dry all summer
TOWN-104-R-2000	19.26	16.21	22.86	26.81	24.21	41.09	6.01	0.00	
TOWN-105-R-2000									No temperature logger - stream very small
TOWN-106-R-2000									Temperature logger dry all summer
TOWN-110-R-2000	18.35	17.10	19.81	22.62	20.96	17.13	0.00	0.00	
TOWN-113-R-2000									Temperature logger dry all summer
TOWN-408-R-2000									Temperature logger lost
TOWN-409-R-2000									Temperature logger lost
TOWN-412-R-2000									Temperature logger lost

Table C-1. (Continued)									
Site	Mean Average Daily Temperature	Mean Minimum Daily Temperature	Mean Maximum Daily Temperature	Absolute Maximum	95th Percentile	Percent Exceedences 20 °C	Percent Exceedences 23.9 °C	Percent Exceedences 32 °C	Notes
UMON-101-R-2000	18.79	18.21	19.46	22.14	20.81	24.13	0.00	0.00	
UMON-103-R-2000	18.69	17.34	20.11	22.81	21.31	24.64	0.00	0.00	
UMON-106-R-2000									Temperature logger lost
UMON-115-R-2000	14.68	14.17	15.25	17.26	16.15	0.00	0.00	0.00	
UMON-117-R-2000	20.24	17.71	24.99	38.14	24.36	55.66	7.18	0.31	
UMON-119-R-2000	17.50	16.37	18.77	21.87	20.22	6.58	0.00	0.00	
UMON-128-R-2000									No temperature logger - stream mostly dry
UMON-131-R-2000									Temperature logger lost
UMON-132-R-2000	16.46	15.52	17.64	25.12	21.73	11.99	0.42	0.00	
UMON-134-R-2000									Temperature logger dry when retrieved
UMON-207-R-2000	19.63	17.51	22.05	26.32	23.90	42.83	4.94	0.00	
UMON-221-R-2000									Temperature logger dry for most of summer
UMON-229-R-2000	18.01	16.99	19.03	21.35	20.37	8.59	0.00	0.00	
UMON-230-R-2000	19.04	17.47	20.77	23.42	22.09	31.31	0.00	0.00	
UMON-304-R-2000									Temperature logger dry for most of summer
UMON-310-R-2000									Temperature logger lost
UMON-322-R-2000	19.75	18.39	21.19	24.04	22.36	47.23	0.13	0.00	
UMON-413-R-2000									Temperature logger lost
UPCK-101-R-2000	20.57	19.31	22.09	24.69	23.32	65.71	1.61	0.00	
UPCK-102-R-2000	18.69	18.51	18.91	20.90	20.41	10.69	0.00	0.00	
UPCK-108-R-2000	22.21	20.72	23.71	29.61	25.49	86.20	22.88	0.00	
UPCK-109-R-2000	21.38	19.29	23.85	28.45	25.43	70.61	14.99	0.00	
UPCK-115-R-2000	21.52	20.08	23.17	28.63	24.91	76.66	9.67	0.00	
UPCK-118-R-2000	18.95	17.65	20.35	23.17	21.51	29.23	0.00	0.00	
UPCK-119-R-2000	18.05	17.55	18.57	20.62	19.97	3.56	0.00	0.00	
UPCK-122-R-2000	20.53	19.17	21.83	25.48	23.75	62.16	4.92	0.00	
UPCK-130-R-2000									Temperature logger dry when retrieved
UPCK-132-R-2000	21.70	20.50	23.12	27.82	25.02	83.37	12.06	0.00	
UPCK-203-R-2000	21.70	20.55	22.97	26.07	24.68	82.22	14.73	0.00	
UPCK-204-R-2000	22.59	21.37	24.02	27.57	25.81	89.31	26.39	0.00	
UPCK-229-R-2000	21.18	20.16	22.24	24.98	23.95	75.74	5.43	0.00	Temperature logger removed on 8/9/00
UPCK-311-R-2000	19.95	19.06	20.98	23.12	22.46	49.99	0.00	0.00	

APPENDIX D

SENTINEL SITE DATA

Table D-1. Sites sampled by MBSS prior to 2000 that met Sentinel site screening criteria. Round One data are shown.

SITE	STREAM NAME	COUNTY	ORDER	STRATA_R	PH_LAB	NO3_LAB	SO4_L AB	DOC_L AB	ACID SOURCE	PERCENT FOREST	FIBI	BIBI	CBI	BKTRFLAG	BLACK-WAT
KE-N-045-108-95	UT CYPRESS BRANCH	KENT	1	COASTAL-E	4.91	0.19	5.84	21	ORG	85.22	1	1.29	1.29	0	1
WI-S-085-102-95	UT NANTICOKE RIVER	WICOMICO	1	COASTAL-E	4.99	1.05	28.6	10	ORG & AD	56.6	1.75	2.14	2.14	0	1
SO-S-004-113-97	MARUMSCO CREEK	SOMERSET	1	COASTAL-E	5.95	1.24	21.12	15.8	ORG & AD	51.35	2	2.14	2.14	0	1
WO-S-038-108-97	MILLVILLE CREEK	WORCESTER	1	COASTAL-E	4.4	0.35	3.99	32.9	ORG	83.23	3.25	1.29	2.27	0	1
KE-N-096-102-95	SWAN CREEK	KENT	1	COASTAL-E	5.86	0.12	17.46	20	ORG & AD	70.33	2.75	1.86	1.86	0	1
CN-N-024-113-96	SKELETON CREEK	CAROLINE	1	COASTAL-E	5.95	0.6	15.9	15.9	ORG & AD	61.01	2.75	2.14	2.14	0	1
CN-N-039-108-96	UN TRIB TO BEAVERDAM DITCH	CAROLINE	1	COASTAL-E	6.04	1.63	17.55	9.1	ORG & AD	50.67	3.75	1.29	2.52	0	1
SO-S-003-111-97	KINGS CREEK	SOMERSET	1	COASTAL-E	4.99	0.67	11.99	24	ORG & AD	72.33	3.25	1.86	2.56	0	1
WI-S-063-220-95	LEONARD POND RUN	WICOMICO	2	COASTAL-E	6.64	2.08	5.28	6	none	56.48	3.25	3	3.13	0	0
SO-S-021-102-97	LORRETTO BRANCH	SOMERSET	1	COASTAL-E	5.73	0.59	17.89	7.8	AD	74.84	3.25	3	3.13	0	0
WI-S-075-206-95	LEONARD POND RUN	WICOMICO	2	COASTAL-E	6.67	1.43	4.72	6	none	63.36	3.75	3	3.38	0	0
QA-N-086-118-95	UT WYE EAST RIVER	QUEEN ANNES	1	COASTAL-E	6.8	1.16	13.26	22	none	57.09	3	3.86	3.43	0	0
WI-S-057-309-97	ADKINS RACE	WICOMICO	3	COASTAL-E	6.32	2.28	10.79	13.4	ORG & AD	53.96	4	3	3.50	0	1
WI-S-057-319-97	ADKINS RACE	WICOMICO	3	COASTAL-E	6.55	1.48	9.56	15.8	none	53.94	4.25	3.57	3.91	0	0
WI-S-057-311-97	ADKINS RACE	WICOMICO	3	COASTAL-E	6.34	2.22	10.89	14.3	ORG & AD	53.63	4.5	4.14	4.32	0	1
CH-S-177-129-95	BEAVERDAM CREEK	CHARLES	1	COASTAL-W	5.3	0.14	7.27	8	AD	89.68	2.75	2.71	2.71	0	1
CA-S-086-209-97	PLUM POINT CREEK	CALVERT	2	COASTAL-W	7.36	0	16.21	3.2	none	74.93	2.75	3.29	3.02	0	0
SM-S-036-107-95	DYNARD RUN	ST. MARYS	1	COASTAL-W	7.25	0.42	12.45	4	none	61.51	2.5	3.57	3.04	0	0
CH-S-033-314-95	MATTAWOMAN CREEK	CHARLES	3	COASTAL-W	6.6	0.24	12.84	4	AD	69.63	3.5	2.71	3.11	0	0
CA-S-078-308-97	FISHING CREEK	CALVERT	3	COASTAL-W	7.23	0.39	19.39	2.8	none	66.43	3.25	3	3.13	0	0
CH-S-270-318-95	GILBERT SWAMP RUN	CHARLES	3	COASTAL-W	6.76	0.23	14.33	3	AD	60.02	2.5	3.86	3.18	0	0
AA-N-063-232-97	DORSEY RUN	ANNE ARUNDEL	2	COASTAL-W	6.72	0.37	18.33	5	none	72.47	4.25	2.14	3.20	0	0
CH-S-039-224-95	UT POMONKEY CREEK	CHARLES	2	COASTAL-W	6.49	0.45	11.21	5	AD	82.19	2	4.43	3.22	0	0
CA-S-210-230-97	BATTLE CREEK	CALVERT	2	COASTAL-W	6.8	0.67	8.46	2.5	none	56.58		3.29	3.29	0	0
PG-N-135-231-97	CHARLES BRANCH	PRINCE GEORGES	2	COASTAL-W	6.81	0.98	33.65	2.3	none	53.17	3.75	3	3.38	0	0
CH-S-331-301-95	MILL RUN	CHARLES	3	COASTAL-W	6.35	0.33	11.62	3	AD	80.88	3.75	3	3.38	0	0
CH-S-044-303-95	GILBERT SWAMP RUN	CHARLES	3	COASTAL-W	6.96	0.68	14.52	1	AD	59.95	3	3.86	3.43	0	0
CH-S-020-322-95	ZEKIAH SWAMP RUN	CHARLES	3	COASTAL-W	6.73	0.49	13.23	6	AD	69.49	4.25	2.71	3.48	0	0
CH-S-123-317-95	BEAVERDAM CREEK	CHARLES	3	COASTAL-W	6.07	0	9.37	3	AD	86.94	3	4.14	3.57	0	0
CH-S-194-321-95	GILBERT SWAMP RUN	CHARLES	3	COASTAL-W	6.71	0.6	13.01	5	AD	59.29	3.5	3.86	3.68	0	0
CH-S-062-313-95	ZEKIAH SWAMP RUN	CHARLES	3	COASTAL-W	6.52	0.51	13.88	5	AD	60.35	4.25	3.29	3.77	0	0
CH-S-039-203-95	UT POMONKEY CREEK	CHARLES	2	COASTAL-W	6.89	0.2	16.16	3	AD	81.43	4.25	3.29	3.77	0	0
SM-S-239-310-95	ST CLEMENTS CREEK	ST. MARYS	3	COASTAL-W	7.07	0.49	10.64	6	none	55.67	4	3.57	3.79	0	0
CH-S-333-216-95	PINEY BRANCH	CHARLES	2	COASTAL-W	6.48	0.78	17.71	4	AD	62.23	4	3.57	3.79	0	0
PG-N-028-301-97	BEAVERDAM CREEK	PRINCE GEORGES	3	COASTAL-W	6.69	1.53	16.04	4	none	63.51	4	3.57	3.79	0	0
SM-S-040-128-95	UT BURNT MILL CREEK	ST. MARYS	1	COASTAL-W	6.32	0.22	8.34	6	AD	67.33	3.75	3.86	3.81	0	0
HA-N-052-202-96	GASHEYS RUN	HARFORD	2	COASTAL-W	7.37	2.32	11.06	2.1	none	53.16	5	2.71	3.86	0	0
SM-S-051-132-95	UT ST CLEMENTS CREEK	ST. MARYS	1	COASTAL-W	6.86	0.2	7.05	4	none	79.26		3.86	3.86	0	0
CH-S-002-207-95	HOGHOLE RUN	CHARLES	2	COASTAL-W	6.62	0.2	10.51	3	AD	83.58	4.5	3.29	3.90	0	0
CH-S-294-236-97	SWANSON CREEK	CHARLES	2	COASTAL-W	6.85	0.6	14.76	2.5	AD	69.33	4.25	3.57	3.91	0	0
CH-S-016-225-95	CLARK RUN	CHARLES	2	COASTAL-W	6.27	0.3	8.87	6	AD	60.29	3.5	4.43	3.97	0	0
CH-S-231-202-97	SWANSON CREEK	CHARLES	2	COASTAL-W	6.82	0.53	13.73	2.6	AD	68.79	4.75	3.29	4.02	0	0
SM-S-199-302-95	ST CLEMENTS CREEK	ST. MARYS	3	COASTAL-W	7.1	0.46	10.31	6	none	56.83	4.25	3.86	4.06	0	0
AA-N-030-223-95	UT DEEP RUN	ANNE ARUNDEL	2	COASTAL-W	7.08	1.3	21.68	3	none	72.6	4.25	3.86	4.06	0	0
PG-N-098-320-97	BEAVERDAM CREEK	PRINCE GEORGES	3	COASTAL-W	6.71	1.15	15.56	4.1	none	65.69	4	4.14	4.07	0	0
CH-S-012-114-95	UT ZEKIAH SWAMP RUN	CHARLES	1	COASTAL-W	6.2	0.34	14.82	3	AD	95.19	3.75	4.43	4.09	0	0
PG-S-035-301-97	SWANSON CREEK	PRINCE GEORGES	3	COASTAL-W	7.01	0.6	14.47	2.8	none	69.83	4.75	3.57	4.16	0	0
CH-S-091-131-97	UN TRIB TO SWANSON CREEK	CHARLES	1	COASTAL-W	6.58	0.35	10.82	3.8	AD	74.62	4.75	3.57	4.16	0	0
SM-S-111-112-95	JARBOESVILLE RUN	ST. MARYS	1	COASTAL-W	6.51	0.35	4.64	7	AD	61.1	4.5	3.86	4.18	0	0
CH-S-180-305-95	ZEKIAH SWAMP RUN	CHARLES	3	COASTAL-W	6.47	0.62	13.5	4	AD	59.91	4.25	4.14	4.20	0	0
CH-S-086-217-95	PINEY BRANCH	CHARLES	2	COASTAL-W	6.19	0.99	16.89	5	AD	55.88	4	4.43	4.22	0	0
SM-S-006-212-95	BURNT MILL CREEK	ST. MARYS	2	COASTAL-W	6.92	0.45	8.38	8	none	60.92	4	4.43	4.22	0	0
PG-S-047-211-97	ROCK BR TO SPICE CREEK	PRINCE GEORGES	2	COASTAL-W	6.61	0.75	23.62	2.2	AD	58.27	5	3.57	4.29	0	0
CH-S-331-304-95	MILL RUN	CHARLES	3	COASTAL-W	6.46	0.33	11.61	3	AD	81.14	4.75	3.86	4.31	0	0
CH-S-231-209-97	SWANSON CREEK	CHARLES	2	COASTAL-W	6.29	0.65	12.3	3.2	AD	64.78	4.75	4.14	4.45	0	0
CH-S-089-205-95	WARDS RUN	CHARLES	2	COASTAL-W	6.27	0.22	7.38	4	AD	80.02	4.75	4.14	4.45	0	0
CH-S-292-211-95	OLD WOMANS RUN	CHARLES	2	COASTAL-W	6.61	0.56	12.85	3	AD	75.83	4.5	4.43	4.47	0	0
CH-S-217-201-95	REEDER RUN	CHARLES	2	COASTAL-W	6.69	0.27	7.36	6	none	89.82	5		5.00	0	0
CH-S-036-213-95	ZEKIAH SWAMP RUN	CHARLES	2	COASTAL-W	6.64	0.27	11.88	5	AD	83.1		3.57	3.57		

Table D-1. Continued)																
SITE	STREAM NAME	COUNTY	ORDER	STRATA_R	PH_LAB	NO3_LAB	SO4_L AB	DOC_L AB	ACID SOURCE	PERCENT FOREST	FIBI	BIBI	CBI	BKTRFLAG	BLACK-WAT	
BA-P-057-209-96	GREENE BRANCH	BALTIMORE	2	EPIDMNT	7.43	2.3	9.72	1.4	none	56.58	2.78	3.44	3.11	0	0	
BA-P-015-120-96	BAISMANS RUN	BALTIMORE	1	EPIDMNT	6.97	2.55	3.99	1.1	AD	58.59	1.89	4.33	4.33	1	0	
HA-P-116-109-96	UN TRIB TO LITTLE GUNPOWDER RIVER	HARFORD	1	EPIDMNT	7.43	2.06	12.12	2.4	none	51.37	3.22	3.22	3.22	1	0	
BA-P-346-321-95	JONES FALLS	BALTIMORE	3	EPIDMNT	8.11	1.87	12.98	2	none	53.37	3.22	3.22	3.22	0	0	
BA-P-025-102-96	BEAVERDAM RUN	BALTIMORE	1	EPIDMNT	6.37	1.53	4.81	4.9	AD	56.69	3.44	3.22	3.33	1	0	
BA-P-077-322-95	NORTH BRANCH	BALTIMORE	3	EPIDMNT	7.65	1.37	4.77	2	none	52.69	2.56	3.44	3.00	0	0	
BA-P-077-315-96	NORTH BRANCH	BALTIMORE	3	EPIDMNT	7.6	1.32	7.36	2.6	none	56.62	3	3.67	3.34	0	0	
HA-P-099-102-97	HOLLAND'S BRANCH	HARFORD	1	EPIDMNT	7.1	0.59	11.3	3.4	none	78.32		3.44	3.44	0	0	
HO-P-182-207-96	SOUTH BR PATAPSCO	HOWARD	2	EPIDMNT	7.71	2.21	9.22	2	none	60	3.89	3	3.45	0	0	
BA-P-143-104-96	WATERSPOUT RUN	BALTIMORE	1	EPIDMNT	7.75	1.23	4.71	2	none	54.85	2.78	4.33	3.56	0	0	
BA-P-313-204-95	RED RUN	BALTIMORE	2	EPIDMNT	7.59	2.09	5.5	2	none	51.88	4.33	3	3.67	0	0	
BA-P-234-109-95	DIPPING POND RUN	BALTIMORE	1	EPIDMNT	6.77	2.51	2.09	1	none	74.33		3.67	3.67	1	0	
HO-P-228-119-97	UN TRIB TO PATUXENT RIVER	HOWARD	1	EPIDMNT	7.69	1.36	7.17	1.5	none	65.92	3.44	4.11	3.78	0	0	
BA-P-008-101-95	UT N BR PATAPSCO RIVER	BALTIMORE	1	EPIDMNT	7.43	1.49	16.14	1	none	55.83	3.67	3.89	3.78	0	0	
BA-P-313-215-95	RED RUN	BALTIMORE	2	EPIDMNT	7.64	1.98	4.98	2	none	51.87	4.56	3.44	4.00	0	0	
BA-P-121-111-96	DELAWARE RUN	BALTIMORE	1	EPIDMNT	7.52	1.6	8.89	1.7	none	78.39		4.33	4.33	0	0	
GA-A-420-325-95	HERRINGTON RUN	GARRETT	3	HIGHLAND	6.05	0.19	7.9	2	AD	91.05	2.71	1.67	1.67	1	0	
FR-B-081-229-96	HUNTING CREEK	FREDERICK	2	HIGHLAND	7.22	1.11	6.72	1.3	none	79.98	2.71	2.11	2.11	1	0	
GA-A-420-323-95	HERRINGTON RUN	GARRETT	3	HIGHLAND	6.07	0.19	8.09	2	AD	91	3	1.89	1.89	1	0	
GA-A-450-113-97	UN TRIB TO CASSELMAN RIVER	GARRETT	1	HIGHLAND	7.49	0.67	17.67	1.3	none	88.15	2.71	3.22	3.22	1	0	
FR-P-302-334-96	OWENS CREEK	FREDERICK	3	HIGHLAND	7.49	1.02	9.07	1.5	none	81.5	4.43	1.67	3.05	0	0	
GA-A-133-112-96	SPRING LICK	GARRETT	1	HIGHLAND	6.92	0.68	13.86	1.1	AD	81.82	2.43	3.67	3.67	1	0	
GA-A-409-102-97	UN TRIB TO YOUGHIOGHENY RIVER	GARRETT	1	HIGHLAND	6.45	0.39	14.7	0.8	AD	92.9	2.43	3.67	3.67	1	0	
GA-A-030-213-97	PINEY CREEK	GARRETT	2	HIGHLAND	7.14	1.08	10.03	2.3	AD	65.32	3.86	2.33	3.10	0	0	
WA-A-089-312-95	BEAR CREEK	WASHINGTON	3	HIGHLAND	7.25	0.89	15.05	2	AD	53.69	3	3.22	3.11	0	0	
GA-A-326-106-95	MILLERS RUN	GARRETT	1	HIGHLAND	7.1	0.33	8.5	4	none	88.67	3	3.22	3.11	0	0	
FR-B-133-222-96	OWENS CREEK	FREDERICK	2	HIGHLAND	7.33	1.35	6.65	1.3	none	83.16	4.14	2.11	3.13	1	0	
GA-A-542-304-97	MUDDY CREEK	GARRETT	3	HIGHLAND	6.54	0.37	8.24	1.9	AD	69.18	3.29	3	3.15	0	0	
FR-P-034-228-96	LITTLE HUNTING CREEK	FREDERICK	2	HIGHLAND	6.86	0.43	6.29	1.2	AD	98.24	3.29	3	3.15	1	0	
FR-P-100-117-96	UN TRIB TO BALLENGER CREEK	FREDERICK	1	HIGHLAND	7.23	2.39	15.12	1.2	none	59.63	2.43	3.89	3.16	0	0	
AL-A-465-324-96	COLLIER RUN	ALLEGANY	3	HIGHLAND	7.24	0.3	17.1	2.1	none	89.16	2.43	3.89	3.16	0	0	
AL-A-202-121-96	WARRIOR RUN	ALLEGANY	1	HIGHLAND	7.28	1.11	44.96	1.1	none	91.95	2.43	3.89	3.16	0	0	
WA-A-144-311-95	BEAR CREEK	WASHINGTON	3	HIGHLAND	7.09	0.72	13.78	2	AD	54.17	3.57	2.78	3.18	0	0	
FR-P-214-342-96	OWENS CREEK	FREDERICK	3	HIGHLAND	7.62	1.38	11.25	1.7	none	53.86	4.71	1.67	3.19	0	0	
GA-A-111-316-95	LITTLE YOUGHIOGHENY RIVER	GARRETT	3	HIGHLAND	7.4	0.38	13.14	2	none	74.48	2.71	3.67	3.19	0	0	
AL-A-626-216-96	MILL RUN	ALLEGANY	2	HIGHLAND	7.51	0.68	12.89	1.1	none	100.6	2.71	3.67	3.67	1	0	
FR-P-294-357-96	HUNTING CREEK	FREDERICK	3	HIGHLAND	7.49	0.8	8.6	1.1	none	66.43	3.86	2.56	3.21	0	0	
AL-A-294-325-96	TRADING RUN	ALLEGANY	3	HIGHLAND	7.17	0.33	24.63	2.9	none	89.67	3.86	2.56	3.21	0	0	
AL-A-177-232-95	DEEP RUN	ALLEGANY	2	HIGHLAND	6.7	0.16	14.91	2	AD	99.01	3	3.44	3.22	0	0	
MO-P-111-136-96	UN TRIB TO LITTLE BENNET CREEK	MONTGOMERY	1	HIGHLAND	6.7	0.85	8.27	1.2	AD	61.54		3.22	3.22	0	0	
AL-A-500-103-95	UT WHITE SULPHUR RUN	ALLEGANY	1	HIGHLAND	6.59	0.15	11.32	2	AD	99.76		3.22	3.22	0	0	
GA-A-432-320-95	BEAR CREEK	GARRETT	3	HIGHLAND	6.99	0.74	8.8	2	AD	75.76	4.14	2.33	3.24	1	0	
AL-A-380-303-96	MILL RUN	ALLEGANY	3	HIGHLAND	7.39	0.26	26.48	2.2	none	91.56	2.14	4.33	3.24	0	0	
AL-A-167-230-95	UT FIFTEENMILE CREEK	ALLEGANY	2	HIGHLAND	6.91	0.16	11.1	1	AD	96.9	2.14	4.33	3.24	0	0	
FR-P-214-303-96	OWENS CREEK	FREDERICK	3	HIGHLAND	7.81	1.38	12.51	1.7	none	54.3	4.43	2.11	3.27	0	0	
FR-P-265-351-96	MIDDLE CREEK	FREDERICK	3	HIGHLAND	8.65	0.99	14.9	2.5	none	57.28	4.43	2.11	3.27	0	0	
WA-A-133-204-95	LONG HOLLOW	WASHINGTON	2	HIGHLAND	7.14	0.2	23.28	3	none	90.07	2.43	4.33	3.38	0	0	
GA-A-542-309-97	MUDDY CREEK	GARRETT	3	HIGHLAND	6.51	0.36	8.16	2.2	AD	69.06	3.57	3.22	3.40	0	0	
GA-A-076-209-96	BLUE LICK RUN	GARRETT	2	HIGHLAND	6.92	0.8	11.54	0.7	AD	86.07	3.57	3.22	3.40	1	0	
GA-A-405-112-95	UT FORD RUN	GARRETT	1	HIGHLAND	6.85	0.75	15.67	6	none	52.74	2.71	4.11	3.41	0	0	
GA-A-358-115-95	UT PINEY CREEK	GARRETT	1	HIGHLAND	7.12	1.98	10.05	2	AD	60.93	2.71	4.11	3.41	0	0	
AL-A-207-307-95	FIFTEENMILE CREEK	ALLEGANY	3	HIGHLAND	6.91	0.26	10.34	2	AD	89.73	2.71	4.11	3.41	0	0	
WA-V-072-104-95	UT ROCKDALE RUN	WASHINGTON	1	HIGHLAND	6.74	0.37	7.55	26	ORG	90.07		3.44	3.44	0	1	
AL-A-215-112-95	UT MAPLE RUN	ALLEGANY	1	HIGHLAND	6.99	0.14	11.99	2	none	100.33		3.44	3.44	0	0	
WA-A-003-308-95	LITTLE TONOLOWAY CREEK	WASHINGTON	3	HIGHLAND	7.34	0.38	18.36	3	none	81.01	3	3.89	3.45	0	0	
AL-A-550-204-96	UN TRIB TO BRICE HOLLOW RUN	ALLEGANY	2	HIGHLAND	7.13	0.37	27.66	2.3	none	87.49	3	3.89	3.45	0	0	
FR-P-298-308-96	OWENS CREEK	FREDERICK	3	HIGHLAND	7.5	1.45	10.43	1.6	none	60.03	4.14	2.78	3.46	0	0	
GA-A-545-301-95	NORTH BRANCH CASSELMAN RIVER	GARRETT	3	HIGHLAND	6.76	0.29	2.5	1	AD	79.98	3.57	3.44	3.51	1	0	
GA-A-120-103-95	UT PINEY CREEK	GARRETT	1	HIGHLAND	7.1	0.68	11.16	1	none	67.06	3.86	3.22	3.54	0	0	
GA-A-128-217-95	UT CHERRY CREEK	GARRETT	2	HIGHLAND	7.12	0.55	7.92	2	none	75.93	3	4.11	4.11	1	0	
GA-A-542-308-97	MUDDY CREEK	GARRETT	3	HIGHLAND	6.48	0.38	8.18	2.1	AD	68.54	3.57		3.57	0	0	
GA-A-090-310-96	BIG RUN	GARRETT	3	HIGHLAND	6.72	0.5	11.81	0.9	AD	97.36	4.14	3	3.57	1	0	

Table D-1. (Continued)

SITE	STREAM NAME	COUNTY	ORDER	STRATA_R	PH_LAB	NO3_LAB	SO4_L AB	DOC_L AB	ACID SOURCE	PERCENT FOREST	FIBI	BIBI	CBI	BKTRFLAG	BLACK-WAT
GA-A-112-101-97	GINSENG RUN	GARRETT	1	HIGHLAND	6.97	0.71	10.84	0.9	AD	63.28		3.67	3.67	1	0
AL-A-255-108-95	UT POTOMAC RIVER	ALLEGANY	1	HIGHLAND	7.14	0.51	17.05	2	none	99.98		3.67	3.67	0	0
FR-P-288-133-96	TRIB TO HUNTING CREEK	FREDERICK	1	HIGHLAND	7.33	0.56	6.49	1.7	none	88.62	4.14	3.22	3.68	0	0
GA-A-121-210-96	BEAR PEN RUN	GARRETT	2	HIGHLAND	6.8	0.57	13.68	1.1	AD	80.26	4.43	3	3.72	1	0
GA-A-008-213-96	BLUE LICK	GARRETT	2	HIGHLAND	6.67	1.2	10.85	1	AD	81.78	4.43	3	3.72	1	0
GA-A-105-318-96	SAVAGE RIVER	GARRETT	3	HIGHLAND	7.19	0.77	14.1	2.6	AD	68.19	3.57	3.89	3.73	0	0
GA-A-395-219-97	MILL RUN	GARRETT	2	HIGHLAND	7.13	0.69	13.6	0.9	AD	80.86	3.57	3.89	3.73	1	0
FR-P-319-352-96	OWENS CREEK	FREDERICK	3	HIGHLAND	7.63	1.27	9.6	1.4	none	67.04	5	2.56	3.78	0	0
MO-P-248-125-96	BENNET CREEK	MONTGOMERY	1	HIGHLAND	7.21	2.26	8.81	0.9	none	56.6	4.14	3.44	3.79	0	0
GA-A-309-221-97	GINSENG RUN	GARRETT	2	HIGHLAND	7.69	1.08	11.51	1	none	70.73	4.14	3.44	3.79	1	0
AL-A-276-323-96	EVITTS CREEK	ALLEGANY	3	HIGHLAND	8.04	0.69	14.35	2.7	none	79.58	4.14	3.44	3.79	0	0
AL-A-688-319-95	FIFTEENMILE CREEK	ALLEGANY	3	HIGHLAND	7.12	0.32	10.09	5	AD	87.36	4.14	3.44	3.79	0	0
GA-A-159-202-96	MIDDLE FORK	GARRETT	2	HIGHLAND	6.83	0.72	14.05	1	AD	90.35	4.14	3.44	3.79	1	0
GA-A-053-206-96	POPLAR LICK RUN	GARRETT	2	HIGHLAND	7.11	0.47	10.75	0.9	AD	93.76	4.14	3.44	3.79	1	0
GA-A-373-220-95	ROCKLICK CREEK	GARRETT	2	HIGHLAND	7.54	0.45	14.98	2	none	54.47	3.29	4.33	3.81	0	0
GA-A-453-310-95	NORTH BRANCH CASSELMAN RIVER	GARRETT	3	HIGHLAND	7.11	0.45	25.42	1	none	78.47	3.57	4.11	3.84	1	0
GA-A-518-220-97	UN TRIB TO YOUGHIOGHENY RIVER	GARRETT	2	HIGHLAND	7.62	2.03	13.04	1.2	none	58.89	3.86	3.89	3.88	1	0
GA-A-236-218-95	BIG SHADE RUN	GARRETT	2	HIGHLAND	7.01	0.46	26.16	0	none	72.91	3.86	3.89	3.88	1	0
GA-A-184-328-96	SAVAGE RIVER	GARRETT	3	HIGHLAND	7.02	0.63	12.28	1.4	AD	82.79	3.86	3.89	3.88	0	0
AL-A-146-301-95	FIFTEENMILE CREEK	ALLEGANY	3	HIGHLAND	6.89	0.29	10.27	2	AD	89.55	3.86	3.89	3.88	0	0
AL-A-441-309-95	WHITE SULPHUR RUN	ALLEGANY	3	HIGHLAND	6.92	0.16	11.59	2	AD	99	3.86	3.89	3.88	0	0
GA-A-314-116-96	UN TRIB TO GLADE RUN	GARRETT	1	HIGHLAND	6.69	0.42	7.17	1.2	AD	71.04		3.89	3.89	0	0
GA-A-309-215-97	GINSENG RUN	GARRETT	2	HIGHLAND	6.58	0.86	9.66	1	AD	70.11	4.43	3.44	3.94	1	0
AL-A-553-306-95	FLINTSTONE CREEK	ALLEGANY	3	HIGHLAND	7.45	0.25	14.21	2	none	88	4.71	3.22	3.97	0	0
GA-A-105-317-96	SAVAGE RIVER	GARRETT	3	HIGHLAND	7	0.74	13.22	2.9	AD	67.75	3.86	4.11	3.99	1	0
GA-A-512-214-96	BEAR PEN RUN	GARRETT	2	HIGHLAND	6.84	0.54	13.45	0.9	AD	73.17	4.14	3.89	4.02	1	0
AL-A-033-314-95	FIFTEENMILE CREEK	ALLEGANY	3	HIGHLAND	7.07	0.32	10.03	2	AD	86.5	4.14	3.89	4.02	0	0
WA-V-170-217-95	TOMS RUN	WASHINGTON	2	HIGHLAND	8.21	0.18	6.46	2	none	80.33	4.43	3.67	4.05	0	0
GA-A-560-201-95	BUFFALO RUN	GARRETT	2	HIGHLAND	7.39	0.46	22.98	2	none	63.04	3.57	4.56	4.07	0	0
GA-A-094-303-97	BEAR CREEK	GARRETT	3	HIGHLAND	7.13	0.99	10.92	0.9	AD	73.2	3.57	4.56	4.07	0	0
GA-A-039-307-97	SOUTH BR BEAR CREEK	GARRETT	3	HIGHLAND	7.28	1.35	12.49	1.1	none	64.42	3.86	4.33	4.10	0	0
GA-A-343-319-97	BUFFALO RUN	GARRETT	3	HIGHLAND	7.33	0.61	18.87	1.3	none	68.76	3.86	4.33	4.10	0	0
GA-A-506-106-97	UN TRIB TO BUFFALO RUN	GARRETT	1	HIGHLAND	7.25	0.4	9.19	1.2	none	69.68		4.11	4.11	0	0
AL-A-199-122-95	UT TERRAPIN RUN	ALLEGANY	1	HIGHLAND	6.6	0.35	11.41	2	AD	99.51		4.11	4.11	0	0
WA-V-120-233-95	SHARMANS BRANCH	WASHINGTON	2	HIGHLAND	7.6	0.96	12.43	3	none	75.91	4.14	4.11	4.13	0	0
GA-A-432-315-95	BEAR CREEK	GARRETT	3	HIGHLAND	6.96	0.65	9.59	1	AD	76.12	4.14	4.11	4.13	1	0
GA-A-107-209-97	LITTLE BEAR CREEK	GARRETT	2	HIGHLAND	6.93	0.81	8.16	0.6	AD	88.2	4.14	4.11	4.13	1	0
AL-A-425-314-96	ELK LICK RUN	ALLEGANY	3	HIGHLAND	8.19	1.04	49.25	1.4	none	84.62	4.14		4.14	0	0
MO-P-366-212-97	TEN MILE CREEK	MONTGOMERY	2	HIGHLAND	7.32	1.36	9.81	2	none	56.24	4.43	3.89	4.16	0	0
GA-A-315-101-96	BLACKLICK RUN	GARRETT	1	HIGHLAND	6.97	1.85	14.02	1.1	AD	60.85	4.43	3.89	4.16	0	0
AL-A-709-303-95	FIFTEENMILE CREEK	ALLEGANY	3	HIGHLAND	6.98	0.29	10.54	2	AD	83.51	4.43	3.89	4.16	0	0
GA-A-247-111-97	FIKES RUN	GARRETT	1	HIGHLAND	7.16	0.6	8.32	0.7	AD	90.29	4.43	3.89	4.16	1	0
FR-P-132-320-96	LITTLE HUNTING CREEK	FREDERICK	3	HIGHLAND	7.25	0.51	7.41	1.9	none	83.79	4.71	3.67	4.19	0	0
GA-A-276-106-96	DOUBLE LICK RUN	GARRETT	1	HIGHLAND	6.77	0.49	12.89	0.8	AD	92.12	4.71	3.67	4.19	1	0
GA-A-304-316-97	SOUTH BR BEAR CREEK	GARRETT	3	HIGHLAND	7.34	1.5	13.05	1.4	none	55.18	3.86	4.56	4.21	0	0
GA-A-062-203-97	MILL RUN	GARRETT	2	HIGHLAND	7.13	0.75	11.16	0.8	AD	85.48	3.86	4.56	4.21	1	0
WA-V-084-116-95	UT LITTLE ANTETAM CREEK	WASHINGTON	1	HIGHLAND	7.31	1.9	12.17	2	none	51.02	4.14	4.33	4.24	0	0
GA-A-999-302-96	SAVAGE RIVER	GARRETT	3	HIGHLAND	7.07	0.8	12.03	1.5	AD	83.46	4.14	4.33	4.24	1	0
WA-V-161-214-95	UT LITTLE BEAVER CREEK	WASHINGTON	2	HIGHLAND	7.37	0.42	7.14	2	none	87.11	4.14	4.33	4.24	0	0
GA-A-279-104-97	UN TRIB TO LITTLE YOUGHIOGHENY R	GARRETT	1	HIGHLAND	7.06	0.55	11.13	1.2	none	67.97	4.43	4.11	4.27	0	0
GA-A-457-114-95	UT LITTLE BEAR CREEK	GARRETT	1	HIGHLAND	7.14	0.59	13.19	1	none	86.85	4.71	3.89	4.30	1	0
GA-A-416-118-96	BLACKHAWK RUN	GARRETT	1	HIGHLAND	6.79	0.83	13.93	0.6	AD	91.89		4.33	4.33	0	0
GA-A-062-222-95	MILL RUN	GARRETT	2	HIGHLAND	7.22	0.63	11.8	1	AD	84.04	4.14	4.56	4.35	1	0
GA-A-062-202-95	MILL RUN	GARRETT	2	HIGHLAND	7.19	0.68	12.07	1	AD	85.4	4.14	4.56	4.35	1	0
GA-A-268-222-97	UN TRIB TO BEAR CREEK	GARRETT	2	HIGHLAND	6.24	1.74	16.2	1	none	51.17	4.43	4.33	4.38	1	0
GA-A-351-117-95	PINEY CREEK	GARRETT	1	HIGHLAND	6.55	0.67	11.44	3	AD	72.05	4.43	4.33	4.38	1	0
GA-A-141-213-95	BEAR CREEK	GARRETT	2	HIGHLAND	7	0.59	8.53	2	AD	60.28	4.14	4.78	4.46	1	0
WA-A-106-124-95	UT LITTLE CONOCOCHIEAGUE CREEK	WASHINGTON	1	HIGHLAND	7.23	0.53	11.6	0	none	95.2		4.56	4.56	0	0
GA-A-493-109-95	LITTLE LAUREL RUN	GARRETT	1	HIGHLAND	6.86	0.27	11.14	2	AD	79.74	4.43	5	4.72	0	0
AL-A-319-219-96	PEA VINE RUN	ALLEGANY	2	HIGHLAND	8.03	0.53	19.5	1.9	none	80.48		3.22	3.22		
AL-A-148-201-96	SEVEN SPRINGS RUN	ALLEGANY	2	HIGHLAND	7.85	0.18	36	2.7	none	84.55		3.22	3.22		
AL-A-578-110-96	UN TRIB TO MILL RUN	ALLEGANY	1	HIGHLAND	6.55	0.5	13.97	1.5	AD	100.28		3.22	3.22		
AL-A-373-113-96	UN TRIB TO SEVEN SPRINGS RUN	ALLEGANY	1	HIGHLAND	7.96	0.17	27.12	2.1	none	69.52		3.44	3.44		

Table D-2. Sentinel sites sampled by MBSS in 2000. Round One data are shown.

SITE	SITENEW	STREAM NAME	COUNTY	ORDER	STRATA_R	PH_LAB	NO3_LAB	SO4_LAB	DOC_LAB	ACID_SOURCE	PERCENT_FOREST	FIBI	BIBI	CBI	BKTRFLAG	BLACKWAT
WO-S-038-108-97	NASS-108-S-2000	MILLVILLE CREEK	WORCESTER	1	COASTAL-E	4.4	0.35	3.99	32.9	ORG	83.23	3.25	1.29	2.27	0	1
KE-N-096-102-95	LOCR-102-S-2000	SWAN CREEK	KENT	1	COASTAL-E	5.86	0.12	17.46	20	ORG & AD	70.33	2.75	1.86	1.86	0	1
CN-N-024-113-96	UPCK-113-S-2000	SKELETON CREEK	CAROLINE	1	COASTAL-E	5.95	0.6	15.9	15.9	ORG & AD	61.01	2.75	2.14	2.14	0	1
WI-S-063-220-95	WIRH-220-S-2000	LEONARD POND RUN	WICOMICO	2	COASTAL-E	6.64	2.08	5.28	6	none	56.48	3.25	3	3.13	0	0
QA-N-086-118-95	WYER-118-S-2000	UT WYE EAST RIVER	QUEEN ANNES	1	COASTAL-E	6.8	1.16	13.26	22	none	57.09	3	3.86	3.43	0	0
NEVER SAMPLED	NASS-301-S-2000	NASSAWANGO CREEK	WICOMICO	3	COASTAL-E											
CH-S-033-314-95	MATT-033-S-2000	MATTAWOMAN CREEK	CHARLES	3	COASTAL-W	6.6	0.24	12.84	4	AD	69.63	3.5	2.71	3.11	0	0
CH-S-331-304-95	NANJ-331-S-2000	MILL RUN	CHARLES	3	COASTAL-W	6.46	0.33	11.61	3	AD	81.14	4.75	3.86	4.31	0	0
CH-S-012-114-95	ZEKI-012-S-2000	UT ZEKIAH SWAMP RUN	CHARLES	1	COASTAL-W	6.2	0.34	14.82	3	AD	95.19	3.75	4.43	4.09	0	0
CH-S-294-236-97	PAXL-294-S-2000	SWANSON CREEK	CHARLES	2	COASTAL-W	6.85	0.6	14.76	2.5	AD	69.33	4.25	3.57	3.91	0	0
SM-S-051-132-95	STCL-051-S-2000	UT ST CLEMENTS CREEK	ST. MARYS	1	COASTAL-W	6.86	0.2	7.05	4	none	79.26		3.86	3.86	0	0
CA-S-086-209-97	WCHE-086-S-2000	PLUM POINT CREEK	CALVERT	2	COASTAL-W	7.36	0	16.21	3.2	none	74.93	2.75	3.29	3.02	0	0
CH-S-002-207-95	PTOB-002-S-2000	HOGHOLE RUN	CHARLES	2	COASTAL-W	6.62	0.2	10.51	3	AD	83.58	4.5	3.29	3.90	0	0
BA-P-025-102-96	LOCH-102-S-2000	BEAVERDAM RUN	BALTIMORE	1	EPIEDMNT	6.37	1.53	4.81	4.9	AD	56.69	3.44	3.22	3.33	1	0
BA-P-077-322-95	JONE-322-S-2000	NORTH BRANCH	BALTIMORE	3	EPIEDMNT	7.65	1.37	4.77	2	none	52.69	2.56	3.44	3.00	0	0
BA-P-077-315-96	JONE-315-S-2000	NORTH BRANCH	BALTIMORE	3	EPIEDMNT	7.6	1.32	7.36	2.6	none	56.62	3	3.67	3.34	0	0
BA-P-234-109-95	JONE-109-S-2000	DIPPING POND RUN	BALTIMORE	1	EPIEDMNT	6.77	2.51	2.09	1	none	74.33		3.67	3.67	1	0
HO-P-228-119-97	RKGR-119-S-2000	UN TRIB TO PATUXENT RIVER	HOWARD	1	EPIEDMNT	7.69	1.36	7.17	1.5	none	65.92	3.44	4.11	3.78	0	0
BA-P-057-209-96	LOCH-209-S-2000	GREENE BRANCH	BALTIMORE	2	EPIEDMNT	7.43	2.3	9.72	1.4	none	56.58	2.78	3.44	3.11	0	0
BA-P-015-120-96	LOCH-120-S-2000	BAISMANS RUN	BALTIMORE	1	EPIEDMNT	6.97	2.55	3.99	1.1	AD	58.59	1.89	4.33	4.33	1	0
GA-A-159-202-96	SAVA-159-S-2000	MIDDLE FORK	GARRETT	2	HIGHLAND	6.83	0.72	14.05	1	AD	90.35	4.14	3.44	3.79	1	0
GA-A-999-302-96	SAVA-225-S-2000	SAVAGE RIVER	GARRETT	3	HIGHLAND	7.07	0.8	12.03	1.5	AD	83.46	4.14	4.33	4.24	1	0
FR-P-288-133-96	UMON-288-S-2000	TRIB TO HUNTING CREEK	FREDERICK	1	HIGHLAND	7.33	0.56	6.49	1.7	none	88.62	4.14	3.22	3.68	0	0
AL-A-626-216-96	PRLN-626-S-2000	MILL RUN	ALLEGANY	2	HIGHLAND	7.51	0.68	12.89	1.1	none	100.6	2.71	3.67	3.67	1	0
GA-A-432-315-95	YOUNG-432-S-2000	BEAR CREEK	GARRETT	3	HIGHLAND	6.96	0.65	9.59	1	AD	76.12	4.14	4.11	4.13	1	0
GA-A-276-106-96	SAVA-276-S-2000	DOUBLE LICK RUN	GARRETT	1	HIGHLAND	6.77	0.49	12.89	0.8	AD	92.12	4.71	3.67	4.19	1	0
AL-A-207-307-95	FIMI-207-S-2000	FIFTEENMILE CREEK	ALLEGANY	3	HIGHLAND	6.91	0.26	10.34	2	AD	89.73	2.71	4.11	3.41	0	0

Table D-3. Sites sampled in MBSS 2000 that met sentinel site screening criteria, including 24 previously-designated Sentinel sites. MBSS 2000 data are shown.

SITE	SITE TYPE	STREAM NAME	COUNTY	ORDER	STRATA_R	PH_LAB	NO3_LAB	SO4_LAB	DOC_LAB	ACID_SOURCE	PERCENT_FOREST	FIBI	BIBI	CBI	BRKTROUT	BLACKWAT
LOC-102-S-2000	SENTINEL	SWAN CREEK	KENT	1	COASTAL-E	6.02	0.085	4.943	33.182	ORG	85.19	2.75	1.29	1.29	0	1
WIRH-220-S-2000	SENTINEL	LEONARD POND RUN	WICOMICO	2	COASTAL-E	6.23	0.548	1.734	16.032	NONE	51.41	3.25	3.57	3.41	0	1
NASS-108-S-2000	SENTINEL	MILLVILLE CREEK	WORCESTER	1	COASTAL-E	4.41	0.082	3.405	36.061	ORG	77.82	2.00	1.00	1.00	0	1
UPCK-113-S-2000	SENTINEL	SKELETON CREEK	CAROLINE	1	COASTAL-E	5.53	0.117	6.413	28.632	NONE	61.01	2.25	2.71	2.71	0	1
UPCK-115-R-2000		TIDY ISLAND CREEK	CAROLINE	1	COASTAL-E	6.51	0.515	9.530	9.478	ORG	67.55	3.25	1.57	2.41	0	1
UPCK-311-R-2000		FORGE BRANCH	CAROLINE	3	COASTAL-E	6.52	2.851	14.234	7.015	NONE	63.21	4.00	3.29	3.65	0	0
CORS-102-R-2000		KIRBY CREEK	QUEEN ANNES	1	COASTAL-E	6.35	0.164	5.435	17.384	NONE	89.92	1.75	3.29	3.29	0	1
MONI-126-R-2000		MONIE CREEK	SOMERSET	1	COASTAL-E	4.42	0.000	1.594	41.757	AD	92.58	1.75	1.00	1.00	0	1
LOWI-113-R-2000		BEAVERDAM CREEK	WICOMICO	1	COASTAL-E	5.63	0.919	9.971	16.018	ORG	57.25	1.75	1.00	1.00	0	1
WIRH-109-R-2000		LEONARD POND RUN	WICOMICO	1	COASTAL-E	4.31	0.263	5.568	28.823	NONE	93.78	1.00	1.00	1.00	0	1
WIRH-111-R-2000		LEONARD POND RUN	WICOMICO	1	COASTAL-E	5.29	0.931	6.277	18.544	ORG	86.73	2.75	1.29	1.29	0	1
WIRH-114-R-2000		MORRIS BRANCH	WICOMICO	1	COASTAL-E	4.42	0.993	14.345	18.600	ORG	59.23		1.86	1.86	0	1
MATT-033-S-2000	SENTINEL	MATTAWOMAN CREEK	CHARLES	3	COASTAL-W	6.73	0.137	9.472	6.957	NONE	70.03	3.50	3.86	3.68	0	0
NANJ-331-S-2000	SENTINEL	MILL RUN	CHARLES	3	COASTAL-W	6.47	0.164	10.634	3.087	ORG	81.25	3.00	3.57	3.29	0	0
PAXL-294-S-2000	SENTINEL	SWANSON CREEK	CHARLES	2	COASTAL-W	6.70	0.313	14.736	3.106	ORG	69.71	3.00	3.86	3.43	0	0
PTOB-002-S-2000	SENTINEL	HOGHOLE RUN	CHARLES	2	COASTAL-W	6.46	0.000	9.926	3.446	NONE	83.55	4.25	3.57	3.91	0	0
ZEKI-012-S-2000	SENTINEL	ZEKIAH SWAMP RUN	CHARLES	1	COASTAL-W	6.52	0.079	7.876	2.566	AD	92.95	3.25	4.14	3.70	0	0
STCL-051-S-2000	SENTINEL	ST CLEMENS CREEK	ST. MARYS	1	COASTAL-W	7.03	0.000	6.053	3.436	NONE	74.93		3.57	3.57	0	0
MATT-210-R-2000		PINEY BRANCH	CHARLES	2	COASTAL-W	6.58	0.259	11.241	3.240	NONE	62.35	3.50	4.14	3.82	0	0
MATT-212-R-2000		MATTAWOMAN CREEK	CHARLES	2	COASTAL-W	7.03	0.188	8.856	2.325	AD	72.47	4.25	4.71	4.48	0	0
MATT-216-R-2000		PINEY BRANCH	CHARLES	2	COASTAL-W	6.35	0.271	11.010	4.679	ORG	61.92	4.25	4.43	4.34	0	0
NANJ-115-R-2000		HILL TOP FORK	CHARLES	1	COASTAL-W	6.09	0.036	3.465	2.811	AD	77.52	3.75	3.00	3.38	0	0
NANJ-205-R-2000		HANCOCK RUN	CHARLES	2	COASTAL-W	5.71	0.000	5.105	10.288	ORG	82.10	1.25	1.86	1.86	0	1
NANJ-308-R-2000		NANJEMOY CREEK	CHARLES	3	COASTAL-W	6.31	0.000	5.094	14.126	AD	87.57	3.50	2.71	3.11	0	1
MATT-320-R-2000		MATTAWOMAN CREEK	CHARLES/ PRINCE GEORGES	3	COASTAL-W	6.60	0.082	8.217	9.655	AD	63.51	3.00	3.57	3.57	0	1
ABPG-108-R-2000		MOSQUITO CREEK	HARFORD	1	COASTAL-W	5.41	0.019	8.964	17.905	ORG	67.59		1.29	1.29	0	1
STMA-104-R-2000		WAREHOUSE RUN	ST. MARYS	1	COASTAL-W	6.76	0.452	10.834	4.242	NONE	81.77	4.75	4.43	4.59	0	0
STMA-110-R-2000		BROOM CREEK	ST. MARYS	1	COASTAL-W	6.32	0.528	10.397	2.314	AD	75.85		4.14	4.14	0	0
STMA-113-R-2000		ST MARY'S RIVER	ST. MARYS	1	COASTAL-W	6.15	0.326	14.553	3.457	NONE	65.97	4.00	3.29	3.65	0	0
STMA-116-R-2000		ST GEORGE CREEK	ST. MARYS	1	COASTAL-W	4.80	0.000	12.645	33.384	AD	76.63		1.00	1.00	0	1
STMA-202-R-2000		ST MARY'S RIVER	ST. MARYS	2	COASTAL-W	6.23	0.217	5.040	8.928	ORG	73.03	3.50	2.43	2.97	0	1
STMA-306-R-2000		ST MARY'S RIVER	ST. MARYS	3	COASTAL-W	6.45	0.306	6.239	5.887	ORG	69.39	3.25	3.86	3.56	0	0
JONE-109-S-2000	SENTINEL	DIPPING POND RUN	BALTIMORE	1	EPIDDMNT	6.41	2.386	2.660	0.792	NONE	76.78		4.11	4.11	0	0
JONE-315-S-2000	SENTINEL	NORTH BR JONES FALLS	BALTIMORE	3	EPIDDMNT	7.52	1.066	6.174	2.007	NONE	56.29	3.22	4.33	3.78	0	0
JONE-322-S-2000	SENTINEL	NORTH BR JONES FALLS	BALTIMORE	3	EPIDDMNT	7.53	0.931	6.745	2.000	NONE	52.35	2.78	4.33	3.56	0	0
LOCH-102-S-2000	SENTINEL	BEAVERDAM RUN	BALTIMORE	1	EPIDDMNT	6.32	2.326	2.360	1.779	AD	56.60	3.00	4.33	4.33	1	0
LOCH-120-S-2000	SENTINEL	BAISMAN RUN	BALTIMORE	1	EPIDDMNT	7.01	1.075	4.918	0.988	AD	62.99	2.78	3.22	3.22	1	0
LOCH-209-S-2000	SENTINEL	GREENE BRANCH	BALTIMORE	2	EPIDDMNT	7.54	1.745	10.518	1.229	NONE	53.91	3.22	3.67	3.45	0	0
RKGR-119-S-2000	SENTINEL	PATUXENT RIVER	HOWARD	1	EPIDDMNT	7.49	1.205	7.586	1.564	AD	66.76	3.89	3.44	3.67	0	0
LIBE-101-C-2000		TIMBER RUN	BALTIMORE	1	EPIDDMNT	7.03	1.049	5.407	1.129	NONE	77.51	3.89	5.00	4.45	1	0
LIBE-102-C-2000		TIMBER RUN	BALTIMORE	1	EPIDDMNT	6.97	1.126	4.826	0.935	NONE	76.96	4.33	4.11	4.22	1	0
LIBE-103-C-2000		COOKS BRANCH	BALTIMORE	1	EPIDDMNT	7.43	1.052	8.377	1.443	NONE	73.15	3.89	4.33	4.11	1	0
LIBE-117-R-2000		LIBERTY RESERVOIR	BALTIMORE	1	EPIDDMNT	6.85	1.049	7.573	1.535	NONE	71.52	3.00	4.11	3.56	0	0
LIBE-204-C-2000		COOKS BRANCH	BALTIMORE	2	EPIDDMNT	7.39	1.003	7.917	1.116	NONE	74.31	3.89	4.56	4.23	1	0
LIBE-203-R-2000		MORGAN RUN	CARROLL	2	EPIDDMNT	7.41	3.749	5.832	1.304	NONE	95.38	4.11	3.44	3.78	0	0
SBPA-329-R-2000		GILLIS FALLS	CARROLL	3	EPIDDMNT	7.56	3.279	4.778	1.317	NONE	76.57	4.11	4.11	4.11	0	0
FURN-101-C-2000		WINCH RUN (BUCK SWAMP CREEK)	CECIL	1	EPIDDMNT	6.66	0.509	4.055	2.224	ORG	86.36	3.89	4.56	4.23	0	0
SWAN-104-R-2000		CARSINS RUN	HARFORD	1	EPIDDMNT	7.39	0.439	6.668	6.159	AD	61.11	3.67	4.11	3.89	0	0
SWAN-105-R-2000		CARSINS RUN	HARFORD	1	EPIDDMNT	7.42	0.582	9.060	4.241	NONE	64.92	3.67	4.11	3.89	0	0
BRIG-212-R-2000		CABIN BRANCH	HOWARD	2	EPIDDMNT	7.08	2.895	4.721	1.678	NONE	61.26	3.22	3.89	3.56	0	0
PATL-222-R-2000		DEEP RUN	HOWARD	2	EPIDDMNT	7.73	0.265	23.172	2.410	NONE	50.65	4.11	3.67	3.89	0	0

Table D-3. (Continued)

SITE	SITE TYPE	STREAM NAME	COUNTY	ORDER	STRATA_R	PH_LAB	NO3_LAB	SO4_LAB	DOC_LAB	ACID_SOURCE	PERCENT_FOREST	FIBI	BIBI	CBI	BRKTROUT	BLACKWAT
FIMI-207-S-2000	SENTINEL	FIFTEENMILE CREEK	ALLEGANY	2	HIGHLAND	7.09	0.196	9.015	2.211	AD	89.69	3.29	3.44	3.37	0	0
PRLN-626-S-2000	SENTINEL	MILL RUN	ALLEGANY	2	HIGHLAND	7.56	0.443	13.174	0.987	NONE	100.00	3.57	4.56	4.07	1	0
UMON-288-S-2000	SENTINEL	HIGH RUN	FREDERICK	2	HIGHLAND	6.52	0.163	3.653	1.603	NONE	81.63	2.43	4.33	4.33	1	0
SAVA-159-S-2000	SENTINEL	MIDDLE FORK RUN	GARRETT	1	HIGHLAND	7.03	0.425	13.162	0.789	AD	90.21	4.43	4.33	4.38	1	0
SAVA-225-S-2000	SENTINEL	SAVAGE RIVER	GARRETT	2	HIGHLAND	7.26	0.452	11.607	2.449	NONE	83.87	3.57	4.78	4.18	1	0
SAVA-276-S-2000	SENTINEL	DOUBLE LICK RUN	GARRETT	2	HIGHLAND	6.75	0.329	12.110	0.700	AD	92.64	4.14	4.33	4.24	1	0
YOUNG-432-S-2000	SENTINEL	BEAR CREEK	GARRETT	4	HIGHLAND	7.01	0.788	9.773	2.329	AD	76.25	3.86	4.78	4.32	1	0
FIMI-103-R-2000		FIFTEENMILE CREEK	ALLEGANY	1	HIGHLAND	6.48	0.095	7.828	1.713	AD	100.00		3.44	3.44	0	0
FIMI-105-R-2000		SIDELING HILL CREEK	ALLEGANY	1	HIGHLAND	6.58	0.145	11.058	1.273	AD	77.19		4.11	4.11	0	0
FIMI-108-R-2000		FIFTEENMILE CREEK	ALLEGANY	1	HIGHLAND	6.91	0.348	7.919	1.769	AD	70.83		3.67	3.67	0	0
FIMI-202-R-2000		BLACK SULFER RUN	ALLEGANY	2	HIGHLAND	7.03	0.259	9.994	1.300	AD	97.12	3.29	3.89	3.59	0	0
FIMI-401-R-2000		FIFTEENMILE CREEK	ALLEGANY	4	HIGHLAND	7.15	0.233	11.613	1.473	NONE	92.27	4.71	4.11	4.41	0	0
FIMI-404-R-2000		FIFTEENMILE CREEK	ALLEGANY	4	HIGHLAND	7.29	0.118	11.672	1.319	NONE	92.85	4.43	2.56	3.50	0	0
FIMI-407-R-2000		FIFTEENMILE CREEK	ALLEGANY	4	HIGHLAND	7.40	0.122	11.725	1.331	AD	92.80	4.71	3.44	4.08	0	0
TOWN-104-R-2000		SAWPIT RUN	ALLEGANY	1	HIGHLAND	6.68	0.000	12.234	2.050	NONE	100.00		3.44	3.44	0	0
TOWN-408-R-2000		TOWN CREEK	ALLEGANY	4	HIGHLAND	7.54	0.219	12.094	1.693	AD	82.58	3.29	4.33	3.81	0	0
TOWN-409-R-2000		TOWN CREEK	ALLEGANY	4	HIGHLAND	7.64	0.296	14.091	1.771	NONE	81.85	4.43	4.78	4.61	0	0
TOWN-412-R-2000		TOWN CREEK	ALLEGANY	4	HIGHLAND	7.86	0.303	14.024	1.766	NONE	81.87	5.00	4.33	4.67	0	0
WILL-102-C-2000		HAZEN RUN	ALLEGANY	1	HIGHLAND	7.94	0.549	14.184	1.598	ORG	98.59	4.43	3.22	3.83	1	0
LMON-136-T-2000		UT LAUREL BRANCH	FREDERICK	1	HIGHLAND	6.93	0.445	10.025	1.478	NONE	57.74		3.22	3.22	0	0
UMON-101-C-2000		LITTLE FISHING CREEK	FREDERICK	1	HIGHLAND	6.70	0.106	1.554	0.841	NONE	99.86	4.43	3.67	4.05	1	0
UMON-119-R-2000		BUZZARD BRANCH	FREDERICK	1	HIGHLAND	7.05	0.139	5.757	1.841	NONE	99.33	2.71	3.67	3.67	1	0
UMON-207-R-2000		LITTLE HUNTING CREEK	FREDERICK	2	HIGHLAND	6.98	0.225	6.246	1.220	AD	75.73	3.86	3.00	3.43	0	0
UMON-221-R-2000		HUNTING CREEK	FREDERICK	2	HIGHLAND	7.42	0.462	7.761	5.658	NONE	80.54	3.86	4.33	4.10	0	0
UMON-229-R-2000		MUDDY RUN	FREDERICK	2	HIGHLAND	7.23	0.309	4.553	1.715	NONE	94.11	3.86	3.00	3.43	0	0
UMON-230-R-2000		HUNTING CREEK	FREDERICK	2	HIGHLAND	7.23	0.411	7.500	2.170	NONE	89.66	3.57	4.33	3.95	0	0
UMON-304-R-2000		FRIENDS CREEK	FREDERICK	3	HIGHLAND	7.75	0.701	13.875	2.199	AD	69.89	4.43	4.11	4.27	0	0
UMON-322-R-2000		HUNTING CREEK	FREDERICK	3	HIGHLAND	7.61	0.455	7.555	2.484	NONE	82.69	4.14	4.11	4.13	0	0
UMON-413-R-2000		TOMS CREEK	FREDERICK	4	HIGHLAND	7.74	0.657	12.358	2.547	NONE	77.24	3.57	3.22	3.40	0	0
CASS-104-R-2000		SOUTH BR CASSELMAN RIVER	GARRETT	1	HIGHLAND	7.02	0.488	22.479	1.402	NONE	78.28	3.86	4.78	4.32	1	0
CASS-110-R-2000		TWOMILE RUN	GARRETT	1	HIGHLAND	7.41	1.562	17.228	1.378	AD	54.96	4.43	3.67	4.05	1	0
CASS-307-R-2000		CASSELMAN RIVER	GARRETT	3	HIGHLAND	6.93	0.400	19.929	1.463	AD	78.80	3.57	4.78	4.18	0	0
LYOU-101-C-2000		BLACK RUN	GARRETT	1	HIGHLAND	7.03	0.267	8.418	7.030	NONE	96.31	4.43	4.78	4.61	1	0
SAVA-101-C-2000		MONROE RUN	GARRETT	1	HIGHLAND	7.20	0.281	12.337	1.066	NONE	96.12	4.14	4.78	4.46	1	0
SAVA-203-C-2000		POPLAR LICK RUN	GARRETT	2	HIGHLAND	7.14	0.324	10.617	1.152	AD	93.62	4.14	4.78	4.46	1	0
SAVA-204-C-2000		CRABTREE CREEK	GARRETT	2	HIGHLAND	7.55	0.392	13.202	0.905	AD	87.35	5.00	5.00	5.00	1	0
YOUNG-202-C-2000		POPLAR LICK RUN	GARRETT	2	HIGHLAND	7.50	0.405	10.539	1.052	AD	92.03	4.43	3.89	4.16	1	0
YOUNG-203-C-2000		PUZZLEY RUN	GARRETT	2	HIGHLAND	7.21	0.805	13.966	0.906	NONE	72.50	4.14	4.78	4.46	1	0
ANTI-101-C-2000		EDGEMONT RESERVOIR	WASHINGTON	1	HIGHLAND	7.54	0.463	10.654	1.760	NONE	87.71	2.14	3.67	3.67	1	0
LTON-108-R-2000		LITTLE TONOLOWAY CREEK	WASHINGTON	1	HIGHLAND	8.11	0.483	19.937	2.735	NONE	60.12	3.00	3.22	3.11	0	0
LTON-113-R-2000		LITTLE TONOLOWAY CREEK	WASHINGTON	1	HIGHLAND	8.28	0.351	21.501	2.358	AD	54.74	3.00	3.22	3.11	0	0

Table D-4. Comparisons of MBSS Round One and 2000 results for selected parameters at Sentinel sites sampled during both Surveys																
SITE (95-97)	SITENEW	SAMPLED	STREAM NAME	ORDER	STRATA_R	PH_LAB	NO3_L AB	SO4_L AB	DOC_LAB	ACIDSRC	PERCENT FOREST	FIBI	BIBI	CBI	BKTRFLAG	BLACKWAT
KE-N-096-102-95	LOCR-102-S-2000	1995	SWAN CREEK	1	COASTAL-E	5.86	0.12	17.46	20	ORG & AD	70.33	2.75	1.86	1.86	0	1
	LOCR-102-S-2000	2000	SWAN CREEK	1	COASTAL-E	6.02	0.085	4.943	33.182	ORG	85.19	2.75	1.29	1.29	0	1
WO-S-038-108-97	NASS-108-S-2000	1997	MILLVILLE CREEK	1	COASTAL-E	4.4	0.35	3.99	32.9	ORG	83.23	3.25	1.29	2.27	0	1
	NASS-108-S-2000	2000	MILLVILLE CREEK	1	COASTAL-E	4.41	0.082	3.405	36.061	ORG	77.82	2.00	1.00	1.00	0	1
CN-N-024-113-96	UPCK-113-S-2000	1996	SKELETON CREEK	1	COASTAL-E	5.95	0.6	15.9	15.9	ORG & AD	61.01	2.75	2.14	2.14	0	1
	UPCK-113-S-2000	2000	SKELETON CREEK	1	COASTAL-E	5.53	0.117	6.413	28.632	NONE	61.01	2.25	2.71	2.71	0	1
WI-S-063-220-95	WIRH-220-S-2000	1995	LEONARD POND RUN	2	COASTAL-E	6.64	2.08	5.28	6	NONE	56.48	3.25	3.00	3.13	0	0
	WIRH-220-S-2000	2000	LEONARD POND RUN	2	COASTAL-E	6.23	0.548	1.734	16.032	NONE	51.41	3.25	3.57	3.41	0	1
QA-N-086-118-95	WYER-118-S-2000	1995	UT WYE EAST RIVER	1	COASTAL-E	6.8	1.16	13.26	22	NONE	57.09	3.00	3.86	3.43	0	0
	WYER-118-S-2000	2000	UT WYE EAST RIVER	1	COASTAL-E	6.89	1.330	9.818	26.695	NONE	55.39	2.75	3.00	2.88	0	0
CH-S-033-314-95	MATT-033-S-2000	1995	MATTAWOMAN CREEK	3	COASTAL-W	6.6	0.24	12.84	4	AD	69.63	3.50	2.71	3.11	0	0
	MATT-033-S-2000	2000	MATTAWOMAN CREEK	3	COASTAL-W	6.73	0.137	9.472	6.957	NONE	70.03	3.50	3.86	3.68	0	0
CH-S-331-304-95	NANJ-331-S-2000	1995	MILL RUN	3	COASTAL-W	6.46	0.33	11.61	3	AD	81.14	4.75	3.86	4.31	0	0
	NANJ-331-S-2000	2000	MILL RUN	3	COASTAL-W	6.47	0.164	10.634	3.087	ORG	81.25	3.00	3.57	3.29	0	0
CH-S-294-236-97	PAXL-294-S-2000	1997	SWANSON CREEK	2	COASTAL-W	6.85	0.6	14.76	2.5	AD	69.33	4.25	3.57	3.91	0	0
	PAXL-294-S-2000	2000	SWANSON CREEK	2	COASTAL-W	6.70	0.313	14.736	3.106	ORG	69.71	3.00	3.86	3.43	0	0
CH-S-002-207-95	PTOB-002-S-2000	1995	HOGHOLE RUN	2	COASTAL-W	6.62	0.2	10.51	3	AD	83.58	4.50	3.29	3.90	0	0
	PTOB-002-S-2000	2000	HOGHOLE RUN	2	COASTAL-W	6.46	0.000	9.926	3.446	NONE	83.55	4.25	3.57	3.91	0	0
SM-S-051-132-95	STCL-051-S-2000	1995	UT ST CLEMENTS CREEK	1	COASTAL-W	6.86	0.2	7.05	4	NONE	79.26		3.86	3.86	0	0
	STCL-051-S-2000	2000	UT ST CLEMENTS CREEK	1	COASTAL-W	7.03	0.000	6.053	3.436	NONE	74.93		3.57	3.57	0	0
CA-S-086-209-97	WCHC-086-S-2000	1997	PLUM POINT CREEK	2	COASTAL-W	7.36	0	16.21	3.2	NONE	74.93	2.75	3.29	3.02	0	0
	WCHC-086-S-2000	2000	PLUM POINT CREEK	2	COASTAL-W	7.07	0.061	14.256	5.199	NONE	74.61	2.00	2.14	2.07	0	0
CH-S-012-114-95	ZEKI-012-S-2000	1995	UT ZEKIAH SWAMP RUN	1	COASTAL-W	6.2	0.34	14.82	3	AD	95.19	3.75	4.43	4.09	0	0
	ZEKI-012-S-2000	2000	UT ZEKIAH SWAMP RUN	1	COASTAL-W	6.52	0.079	7.876	2.566	AD	92.95	3.25	4.14	3.70	0	0
BA-P-234-109-95	JONE-109-S-2000	1995	DIPPING POND RUN	1	EPIEDMNT	6.77	2.51	2.09	1	NONE	74.33		3.67	3.67	1	0
	JONE-109-S-2000	2000	DIPPING POND RUN	1	EPIEDMNT	6.41	2.386	2.660	0.792	NONE	76.78		4.11	4.11	0	0
BA-P-077-315-96	JONE-315-S-2000	1996	NORTH BR JONES FALLS	3	EPIEDMNT	7.6	1.32	7.36	2.6	NONE	56.62	3.00	3.67	3.34	0	0
	JONE-315-S-2000	2000	NORTH BR JONES FALLS	3	EPIEDMNT	7.52	1.066	6.174	2.007	NONE	56.29	3.22	4.33	3.78	0	0
BA-P-025-102-96	LOCH-102-S-2000	1996	BEAVERDAM RUN	1	EPIEDMNT	6.37	1.53	4.81	4.9	AD	56.69	3.44	3.22	3.33	1	0
	LOCH-102-S-2000	2000	BEAVERDAM RUN	1	EPIEDMNT	6.32	2.326	2.360	1.779	AD	56.60	3.00	4.33	4.33	1	0
BA-P-015-120-96	LOCH-120-S-2000	1996	BAISMANS RUN	1	EPIEDMNT	6.97	2.55	3.99	1.1	AD	58.59	1.89	4.33	4.33	1	0
	LOCH-120-S-2000	2000	BAISMANS RUN	1	EPIEDMNT	7.01	1.075	4.918	0.988	AD	62.99	2.78	3.22	3.22	1	0
BA-P-057-209-96	LOCH-209-S-2000	1996	GREENE BRANCH	2	EPIEDMNT	7.43	2.3	9.72	1.4	NONE	56.58	2.78	3.44	3.11	0	0
	LOCH-209-S-2000	2000	GREENE BRANCH	2	EPIEDMNT	7.54	1.745	10.518	1.229	NONE	53.91	3.22	3.67	3.45	0	0
HO-P-228-119-97	RKGR-119-S-2000	1997	UN TRIB TO PATUXENT R	1	EPIEDMNT	7.69	1.36	7.17	1.5	NONE	65.92	3.44	4.11	3.78	0	0
	RKGR-119-S-2000	2000	UN TRIB TO PATUXENT R	1	EPIEDMNT	7.49	1.205	7.586	1.564	AD	66.76	3.89	3.44	3.67	0	0
AL-A-207-307-95	FIMI-207-S-2000	1995	FIFTEENMILE CREEK	3	HIGHLAND	6.91	0.26	10.34	2	AD	89.73	2.71	4.11	3.41	0	0
	FIMI-207-S-2000	2000	FIFTEENMILE CREEK	3	HIGHLAND	7.09	0.196	9.015	2.211	AD	89.69	3.29	3.44	3.37	0	0
AL-A-626-216-96	PRLN-626-S-2000	1996	MILL RUN	2	HIGHLAND	7.51	0.68	12.89	1.1	NONE	100.6	2.71	3.67	3.67	1	0
	PRLN-626-S-2000	2000	MILL RUN	2	HIGHLAND	7.56	0.443	13.174	0.987	NONE	100.00	3.57	4.56	4.07	1	0
GA-A-159-202-96	SAVA-159-S-2000	1996	MIDDLE FORK RUN	2	HIGHLAND	6.83	0.72	14.05	1	AD	90.35	4.14	3.44	3.79	1	0
	SAVA-159-S-2000	2000	MIDDLE FORK RUN	2	HIGHLAND	7.03	0.425	13.162	0.789	AD	90.21	4.43	4.33	4.38	1	0
GA-A-999-302-96	SAVA-225-S-2000	1996	SAVAGE RIVER	3	HIGHLAND	7.07	0.8	12.03	1.5	AD	83.46	4.14	4.33	4.24	1	0
	SAVA-225-S-2000	2000	SAVAGE RIVER	3	HIGHLAND	7.26	0.452	11.607	2.449	NONE	83.87	3.57	4.78	4.18	1	0
GA-A-276-106-96	SAVA-276-S-2000	1996	DOUBLE LICK RUN	1	HIGHLAND	6.77	0.49	12.89	0.8	AD	92.12	4.71	3.67	4.19	1	0
	SAVA-276-S-2000	2000	DOUBLE LICK RUN	1	HIGHLAND	6.75	0.329	12.110	0.700	AD	92.64	4.14	4.33	4.24	1	0
FR-P-288-133-96	UMON-288-S-2000	1996	TRIB TO HUNTING CREEK	1	HIGHLAND	7.33	0.56	6.49	1.7	NONE	88.62	4.14	3.22	3.68	0	0
	UMON-288-S-2000	2000	TRIB TO HUNTING CREEK	1	HIGHLAND	6.52	0.163	3.653	1.603	NONE	81.63	2.43	4.33	4.33	1	0
GA-A-432-315-95	YOUNG-432-S-2000	1995	BEAR CREEK	3	HIGHLAND	6.96	0.65	9.59	1	AD	76.12	4.14	4.11	4.13	1	0
	YOUNG-432-S-2000	2000	BEAR CREEK	3	HIGHLAND	7.01	0.788	9.773	2.329	AD	76.25	3.86	4.78	4.32	1	0

